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THE DISPLACEMENT OF TERNS BY HERRING GULLS AT THE WEEPECKET ISLANDS

By ETHEL M. CROWELL AND SEARS CROWELL

For over forty years Common and Roseate Terns *(Sterna hirundo* and *Sterna dougalli)* have nested at the Weepecket Islands. With an adult population of 3500 terns, this colony has been about fourth in size among the tern colonies of southern Massachusetts. Tern Island, Chatham; Ram Island, Mattapoisett; and Penikese Island are the sites of larger colonies. In some seasons the colonies at Muskeget Island, Billingsgate Island, and Egg Island, Hyannis, have been of comparable size.

Since 1940 no terns have nested at the Weepeckets. In their place is a flourishing colony of Herring Gulls *(Larus argentatus)*. This report is a description and analysis of the factors responsible for this displacement of terns by gulls.

The Weepecket Islands consist of one large island and two very small ones. Large Weepecket is 1560 feet long; but at its widest only 650 feet. Its area is about 12 acres. Middle Weepecket and Outer Weepecket are much alike. Each is about 100 feet long and half as wide. The soil is the original glacial till, even on the little islands where the highest point is only 10 to 12 feet above high tide mark. In spite of rather severe erosion, accelerated by the hurricanes of 1938 and 1944, the islands retain their shape and total area. In this respect they differ from Tern Island and Muskeget where the action of storms may change conditions greatly from year to year.

Large Weepecket is at lat. 41°30′40″ N, long. 70°44′30″ W, lying 2000 feet north of Naushon Island in Buzzards Bay. Middle Weepecket

is 1800 feet NNE from Large Weepecket, and Outer Weepecket is 1100 feet farther north.

Large Weepecket is covered by a mixture of many plants. Bayberry, sumac, blackberry, and wild rose cover the central portions. Pokebush, beach grass, and poison ivy cover the edges and ends. In most years there is an extensive beach on the east side, but elsewhere and on the small islands the rocky shore is close to the eroded banks of the glacial till. At present the two small islands are bare of vegetation, though prior to the hurricane of 1938 they were densely covered by grass, blackberry, and poison ivy.

Earlier descriptions of the islands and the tern colony are given by Howe (1897), Jones (1903), and Cahn (1916). In the interval between the visit of Howe and that of Jones the colony increased from 200 to 1500 adult terns. During three of these years Captain Olsen of Naushon served as warden. He tells us that on at least two occasions he apprehended egg collectors. We are indebted to Dr. Stanley Cobb for the figures for July 4, 1905, and for other observations both at Muskeget and Penikese. Cahn estimated that the colony contained 4000 breeding terns in 1915; yet ten years later it was reduced to a few hundred.

Our own observations at Weepecket began in 1925, and have been made regularly since then. For each year an estimate of the adult tern population is shown in Table 1. These vary in accuracy but we believe they are correct within 25%. Both Common and Roseate Terns are included in the estimate. There is about one Roseate Tern to each three Common Terns. This is shown in the totals of young banded: 1479 Roseate, 5905 Common Terns.

An objective determination of colony size might be based on the number of young terns banded. This would show, at least, the minimum size of the colony. The year 1931 may be cited as a favorable example since mortality of chicks was low and banding was thorough. In that year 1803 young Common Terns were banded. If we add one-third or 601 to include the Roseate Terns (the actual figure that year was 570) this would mean 2404 young terns (actually 2373). Even in a good season it is unlikely that there are more than one and a half young per pair of adults. Using that assumption the adult tern population would be 3606. Taking into account the fact that not all of the young are found and banded, our estimate of 3500 adults in that season appears conservative. Unfortunately, in a season when the mortality of young is high there may be no correlation between the number of young banded and the adult population.

TABLE 1

LARGE WEEPECKET ISLAND

Year	Estimated population of adult terns	Number of immature Common Terns banded	% of immature Common Terns recovered	Success of the season
1896	200 (Howe)			
1902	900 (Dutcher)			
1903	1500 (Jones)			
1905	2500 (Cobb)			
1915	4000 (Cahn)			
1925	200	10	0.0	
1926	300	19	0.0	
1927	600	168	0.0	
1928	800	191	0.5	
1929	1500	477	0.6	
1930	2500	751	0.7	fair
1931	3500	1803	2.3	excellent
1932	3500	1	0.0	zero
1933	3500	446	2.2	good
1934	3500	1135	2.3	excellent
1935	1500	89	2.2	fair
1936	2000	198	2.2	fair
1937	1000	123	1.0	poor
1938	1200	0	0.0	zero
1939	2000	586	2.0	good
1940	1000	8	0.0	zero
1941	4			
1942	10	No young terns after 1940		
1943	0			
1944	not over 10			
1945	not over 10			

Table 1 shows the number of young Common Terns banded each season, partly as a check on the minimum adult population, but especially as an indication of the success of the colony in that season.

The next column gives the per cent of young Common Terns recaptured after leaving Weepecket. This shows whether the young actually did mature and leave the island to become a part of the general tern population. The exact per cent is not significant because the capture of one bird more or less would alter the figure considerably. In the last column is a statement of the success of the season.

A study of Table 1 makes it clear that the colony grew rapidly after 1925 and attained a maximum in 1931 of not less than 3500. The seasons of 1931, 1933, 1934, and 1939 were successful in terms of reproduction. Some other seasons were partly successful, as indicated

by the percentage of recoveries, but the number produced was small. There has been no successful reproduction at Weepecket since 1939, and only a few terns have even nested at the islands since 1940.

In 1930 a Herring Gull nest was found on Middle Weepecket Island. It is an interesting coincidence that this is the same island where Vinal Edwards discovered one nesting pair of Herring Gulls in 1888 (MacKay, 1892), the only record of their nesting in Massachusetts until 1912 (Forbush). In 1931 a pair of gulls nested on each of the small Weepeckets. By 1934 the terns had disappeared from Middle and Outer Weepecket, and 50 to 100 gulls were in their place. In 1935 two pairs of gulls nested on Large Weepecket, and by 1940 there were 400 there. The details of these events are shown in Table 2.

TABLE 2

POPULATION OF ADULT TERNS AND GULLS

Year	Large Weepecket I.		Middle Weepecket I.		Outer Weepecket I.	
	Terns	Gulls	Terns	Gulls	Terns	Gulls
1930	2500	0	100	2	100	0
1931	3500	0	200	2	200	2
1932	3500	0	100	2	10	20
1933	3500	0	0	50	2	100
1934	3500	0	0	50		
1935	1500	4	0	100		
1936	2000	12*	0	100	0	150
1937	1000	6*	0	100	0	150
1938	1200	0				
1939	2000	100				
1940	1000	400			0	125
1941	4	400	0	125	0	125
1942	10	1000	0	125		
1943	0	1000			0	125
1944	not over 10	500				
1945	not over 10	250	0	60	0	50

*In 1936 agents of the U. S. Fish and Wildlife Service counted and needled 1562 Herring Gull eggs at the Weepecket Islands on June 4. However, when we visited the large island four days later only a few nests were being used and we did not find abandoned eggs nor nests. It is probable that their figures include all three Weepeckets but even so there is an unexplained discrepancy in the data for 1936. In 1937 they found 321 eggs on May 17.

Table 2 shows clearly that the tern colony declined as the gulls increased. We believe this apparent cause of the displacement of terns is the real cause. By what means did the gulls bring about the abandonment of the colony by the terns?

Direct damage of tern eggs and young by gulls is not often observed. In 1932, however, the Herring Gulls evidently did considerable damage at Weepecket. On June 12 of that year we found the tern colony at Large Weepecket in good condition, with as many nests as in the previous year. On June 18 about 40 Herring Gulls were on the beach when we approached Weepecket. They left when we landed and were not seen again that day. On July 4 we found that many tern nests had been washed by a recent storm and that the eggs of these and others had been broken and cleaned out. Herring Gulls were at the island and their tracks were around broken eggs. Only ten young terns were seen and these were all newly hatched. The adult tern population was estimated at 1000, less than one-third of what it had been earlier. Our notes contain the entry: "Adults indifferent." One week later Herring Gulls, broken tern eggs, 50-75 adult terns, and three good nests were all that remained of the promising colony of mid-June. On July 11 we also visited Middle Weepecket where there were 100 adult terns and several Herring Gulls. No young terns were seen. We found one dead young Herring Gull in a nest and beside it the remains of two adult terns. At Outer Weepecket we banded eleven young gulls but were unable to penetrate the dense growth to capture others. About 100 adult gulls were overhead or on the water nearby. There were about ten terns overhead but we found no other evidence of their nesting on the outer island. We believe that the conditions of 1932 were not repeated in an extensive way in subsequent years.

It is certainly true that gulls and terns may nest successfully on the same island and in close proximity to one another. This was true at both Penikese and Muskeget for nearly twenty years. At Muskeget the terns bred successfully in spite of large numbers of both Herring and Laughing Gulls. At Penikese there is a colony estimated by Griffin (1943) to consist of 600-800 adult Herring Gulls. Our occasional observations there, including one visit this year, support his estimate. At Penikese the gulls use only the northeast corner which has the same area as Large Weepecket. The number of gulls there, and hence the density of population, is not much different from that at Large Weepecket from 1942 to 1944. However, Penikese is seven times as large as Weepecket. This leaves 72 acres free from gulls. Those gulls which have nested in this area have been evicted by the warden. The terns are distributed in groups of various sizes and densities with the largest concentrations near the center and north end of the island. We estimated the adult tern population on July 16, 1945, to be 5000. It has been much more in some seasons. In addition to the gulls at the northeast corner of Penikese there is another colony of several hundred on nearby Gull Island.

The density of gull nests at Large Weepecket and at the northeast corner of Penikese is much less than on the small Weepeckets or on Gull Island. For the former there are 500 square feet per nest while on the small Weepeckets only 60 square feet per nest.

It would be desirable to correlate the increase in Herring Gulls at Weepecket with the history of their invasion of the Massachusetts coast. It would also be desirable to compare the effects observed at Weepecket with those at other islands. The early records of the immigration are given by Forbush (1925): a few nests near Edgartown, on Skiffs Island, and at Muskeget. Cobb found 30 nesting adults on South Beach Bar, Muskeget, in 1922. MacKay (1925) described their nesting there three years later. Mr. Joseph A. Hagar, State Ornithologist, has made a careful study of conditions at Muskeget, where the Herring Gull population of southern Massachusetts is chiefly concentrated, and where terns no longer nest in significant numbers. When his very thorough data are published we shall be much better able to judge the magnitude and effects of the Herring Gull invasion. For the Maine coast, Gross (1945) states that dozens of tern colonies as well as the Laughing Gull colonies mentioned in his paper have been crowded out by the larger Herring and Black-backed Gulls.

In 1939, although there were about 50 gull nests at Large Weepecket, 2000 terns nested and raised young in satisfactory numbers. However, all of the gull nests were localized in one part of the island. Tern nests were not found in the area used by the gulls. This was the last successful season for terns at Weepecket. The following year, 1940, terns nested at only two sites, while gulls were scattered over all other sections of the island. The number of nests was estimated at: Herring Gull 200, tern 300, on June 23. One week later there were many less tern nests and more adult terns overhead than the number of nests would indicate.

Since 1940 a few terns, but not more than ten in any season, may have nested at Weepecket. The Herring Gulls increased to over 1000 but in 1944 had apparently declined somewhat. We were unable to go to the island that year but Nelson Marshall kindly gave us his estimate of 500 gulls on July 27. He also observed a few tern nests on the shore. This year, on July 5, we tried to count all of the gull nests, probably missing not over 10 per cent. There were only 84 nests plus 14 young gulls not in nests. This would indicate a decline in the Herring Gull population to not over 250. A similar decline is evident at the two small Weepeckets.

At Middle Weepecket there were but three nests, and only 17 young gulls were caught. Some young were overlooked and some swam

offshore. The adult population was 50-75, only half that of previous years. Outer Weepecket was observed only from a distance. There appeared to be about the same number of young and adult gulls as on Middle Weepecket.

In reviewing the events at Weepecket we reach these conclusions as to the factors responsible for the displacement of terns by the Herring Gull. 1) Direct destruction of tern nests, eggs, and young by gulls is not sufficiently common to account for abandonment of the colony. Only in the year 1932, before Herring Gulls were nesting on Large Weepecket, was the active destruction by the gulls extensive enough to be significant. 2) It is clear that terns can nest successfully at the same island that is being used by gulls, provided, however, that there is sufficient room so that the terns can nest in an area apart from the gulls. This was the situation at Weepecket in 1939, and was the case at both Penikese and Muskeget for several years. 3) It seems probable that a tern is incapable of proper nesting behavior when its own nest is too close to that of a gull. Even though the gull may ignore the tern, its presence creates a disturbance to the normal activities of the latter. Palmer (1941, p. 27) expresses a similar idea: "I feel that there is a more basic . . . [cause of desertion] . . . namely, the detrimental effect on the terns' breeding cycle of the presence of a species which has a different rhythm of activities." In terms of Weepecket we should say that, as the gulls became dispersed, no area remained where a pair or group of terns could nest without being too close to a gull nest.

We are able to determine fairly well what has been the fate of the terns which emigrated from Weepecket. Fortunately many of the adults had been banded. For the period 1935 to 1938, 13 per cent of the adults captured were terns previously banded. Trapping operations by Dr. O. L. Austin and others have resulted in the recapture of 18 Common Terns which had previously been taken on nests at Large Weepecket. Of these 18, only ten have been taken since the final abandonment of the Weepecket colony in 1940. Thus it is clear that Weepecket terns had often moved to other sites, even prior to the disruption of the colony. Conversely two terns banded when adults at Tern Island and one from Penikese were taken at Weepecket prior to 1941. If one also considers the interchange of birds banded when immature, the contribution of colonies to one another is far more striking. Of the 5905 Common Terns banded as nestlings at Weepecket, 32 have been taken on nests at other colonies. Eleven born elsewhere have been taken at Weepecket.

TABLE 3

COMMON TERNS BANDED AS ADULTS AT WEEPECKET AND RECAPTURED AT OTHER COLONIES

Year banded	Year Recaptured	Place of Recapture	
1931	1935	Tern I., Chatham	
1934	1935	" " "	Total to Tern Island: 9
1934	1935	" " "	
1934	1936 & 1943	" " "	
1934	1940	" " "	
1934	1942 & 1943	" " "	
1940	1942	" " "	
1940	1943	" " "	
1940	1943	" " "	
1930	1944	Ram I., Mattapoisett	Total to Ram Island: 3
1934	1938	" " "	
1936	1940	" " "	
1935*	1938	Penikese Island	
1934	1941	" "	Total to Penikese: 4
1935	1938	" "	
1939	1940	" "	
1935	1941	Plymouth Beach	
1934	1936	Egg I., Hyannis	

*Originally banded when immature, in 1931, at Weepecket.

The recoveries of Weepecket terns at other colonies (Table 3) support Austin's (1940) opinion that the fate of an individual colony has little effect on the total population of a larger area. The recovery of more Weepecket terns at Tern Island, Chatham, a distance of 60 miles, than from Penikese, only ten miles away seems to show that Austin is in error in excluding the Weepecket colony from his "Cape Cod Group" and placing it with Muskeget, Penikese, and Ram Island, Mattapoisett, in a "Vineyard Group." Actually the trapping at Tern Island has been so much more intensive than at other colonies that no quantitative appraisal of the distribution can be made on the basis of Table 3. We can only say that the former Weepecket terns have entered into the general population of the area and have joined several different colonies.

Is it likely that terns will recolonize the Weepeckets? This is probable if the Herring Gulls abandon or are forced out of these islands. The reduction in the number of gulls at Weepecket, in the last two years, may indicate a trend which if continued would soon leave the island unoccupied. All of the important Cape Cod tern colonies have been abandoned at one time or another (Austin, 1940). They have been recolonized whenever conditions at the site became favorable.

There always seems to be a small number of terns "trying out" new sites. At Woods Hole, for example, there was a colonization on a tiny spit projecting into Sheep Pen Cove from the mainland of Naushon Island. About forty terns used this site in 1931 and 1932. Young were not successfully raised, probably because of predators, and the location was abandoned. Two other minor colonies have existed at Woods Hole. One of these at Pine Island consisted of as many as forty adults and persisted successfully for several years until the island's destruction by the hurricane of 1938. The other, on an islet less than 150 feet long and 30 wide between Ram and Devil's Foot Islands, has also supported as many as forty terns, and has been occupied for at least the last twelve years. The presence of a few terns at Weepecket during the last five years seems to suggest that the site has not been abandoned completely even though successful reproduction has not been achieved. The reduction in vegetation by storms has created more nesting territory at Weepecket than has been the case at any previous time in our experience. If the Herring Gulls abandon the colony or are driven out it is probable that the colony would soon regain its former importance.

SUMMARY

1. The changes in population at the colony of Common and Roseate Terns at Weepecket Island, Mass., is described for a period of twenty years.

2. During the past ten years this colony of 3500 terns has been replaced by breeding Herring Gulls.

3. In only one season was there evidence that the gulls were seriously predatory on the terns.

4. The terns are probably incapable of successful reproductive activity if gulls are near, even though the latter do no direct injury.

5. The members of the colony have been redistributed to other colonies of southern Massachusetts as shown by recoveries of banded birds.

6. Conditions favor a recolonization by the terns if the gulls are evicted or abandon the islands.

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THE STATUS OF THE CAPE COD TERNS IN 1944; A BEHAVIOUR STUDY

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Each added year of work done by the Austin Ornithological Research Station in the Cape Cod group of tern colonies compiles further evidence which sustains previous conclusions concerning major traits in the behaviour of the Common Tern *(Sterna hirundo)*. At the same time trends, hitherto unrecognized, become evident. The latter, while of minor importance, function, at least collectively, in maintaining the species' welfare.

Continued observation has shown that deviations from the behaviour pattern as a whole are far less obvious and distracting when the doings of the entire group, a large colony or an aggregate of small colonies are analyzed rather than those of a few individuals, also that adherence to the major rules of conduct increases with each added year of age. The credibility of a determination of the behaviour pattern of the Common Tern and an evaluation of its details is in direct relation to the number of birds from whose actions it has been deduced, since there are wide divergences in both the physical and mental attributes of individuals. For example, in half-grown chicks the alert aggressiveness and robustness of the smaller brown plumaged birds contrasts

[1]Contribution No. 40 by the Austin Ornithological Research Station.

sharply with the apathy and low vitality of the larger gray colored young. Also, in small colonies, notably in such matters as reaction to intrusion and the maintenance of territorial rights, behaviour, while fundamentally identical, does not duplicate that observed in terneries having several thousand numbers. Our concept of the pattern has resulted from the study of thirteen usual and what may be considered normal nestings and, in addition, two altered considerably by marked predation. The validity and effectiveness of specific traits, especially those of major importance—as are the alignment of individuals, the selection of nesting sites and reaction to frustration—are demonstrated better by being subjected to tests imposed by a nesting which varies so much from the usual one that it must be considered abnormal. This occurred in 1944 when, subsequent to a most auspicious start, serious mishaps interrupted the breeding routine, disrupted the initial distribution and compelled the extensive readjustments without which necessary reproduction would not have been achieved.

The alignment of the Cape Cod group of tern colonies (which, for fifteen years, has had a stationary aggregate population of thirty thousand birds) has been previously described (Austin, Some Aspects of Individual Distribution in the Cape Cod Tern Colonies, *Bird-Banding*, Vol. XI, No. 4, October, 1940). The group is self-sustaining and free from association with other groups during the nesting season. The component colonies occupy an almost rectangular area with its long sides about forty miles, the shorter ones fifteen and twenty in extent. Recently the largest colonies have occupied the four corners, Tern Island one, Plymouth diagonally opposite a second, Billingsgate Island and Jeremeys Point another, Bird and Ram Islands the last. From year to year the smaller flocks have nested on sundry sites along the borders; always a few pairs locate on isolated beaches and sand dunes. Consistently the trend has been toward amalgamation in spite of the existence of several apparently ecologically desirable but unutilized locations. Since, over the last decade, the group's total population has not increased and particularly because a few feet of terrain is the maximum requirement of a breeding pair, there is no necessity for young birds spreading out into adjacent territory as is the exigency of some avian species. For that matter, we are sure Tern Island alone could domicile adequately the entire Common Tern membership of the Cape Cod group. This year, in the initial site selection, the habitual proclivity toward cohesion into one colony attained its maximum at Tern Island.

On May 2nd, 1944, fishermen observed the first returning terns offshore; two days later, May 4th, the terns arrived at Tern Island, a site regularly occupied before the others for its tenanting colony contains a preponderance of older birds which always nest much earlier than do their juniors. On May 19th, 2,500 terns were present; 6,000

on May 24th. The nights of May 24th and 25th, when egg-laying had become extensive, the temperature dropped below freezing. By May 29th the population had grown to 13,000; June 2nd it was estimated conservatively that 18,000 were domiciled on the site, egg laying was approaching its peak and was commensurate with the size of the colony.

On June 6th a complete survey of the island was made. It showed that egg-deposition equalled the maximum ever seen on this ternery, also that there had been no removal or destruction of clutches. No rat holes nor other evidence of the presence of these predators were discovered. However, on the north end of the island, 14 long dead adults were found, presumably decapitated by a single owl. Despoilment by this bird ceased June 23rd with the death of its 39th victim.

The first chick hatched June 8th, three days earlier than in 1943, confirming the impression that nesting had been at least on schedule. June 10th and 11th were very cold, stormy days. On the latter, all other nesting sites in the Cape group's range with the exception of Plymouth, Ram and Bird Islands were visited and found to be absolutely unoccupied, accounting for the unusual concentration at Tern Island. Up to now this colony had fared so well it was believed a record-breaking chick yield would ensue.

Now began a series of events which terminated in a practically complete frustration of the Tern Island colony in its initial nesting. On June 9th there seemed to be fewer birds on the site than on the two preceding days, but no accurate estimate was made. On June 12th, after an absence of three days, it was certain that the population had shrunk considerably. When a staked out quadrant near the south end of the island was reached, it was seen that a number of marked clutches had disappeared. This suggested rat predation. Immediate search disclosed three rodent burrows in the nearby bank. As usual, this rat invasion was coincident with hatching now well under way. The burrows were gassed thoroughly and their entrances plugged. The following day was spent making a complete and minute inspection of the entire rookery. The rat holes found and gassed the day before remained closed, with no new openings nearby, which indicated the death of their occupants. No other rat holes were found, and the thorough plowing done in the early spring precluded the existence of hidden entrances. No empty nests were seen other than those already mentioned.

The size of the colony dwindled daily to 8,000 June 17th, to 4,000 at most June 26th. Concurrently, the behaviour of the colony changed rapidly and radically from a peaceful concentration on incubation, to the wildness which characterizes smaller or much disconcerted flocks. During this nine-day interval simple nest desertion, as shown by the presence of cold, unturned clutches, increased progressively. The aban-

donment was generalized and even over the entire island. No new rat holes were found on frequent searches.

Coincident with nest desertion there was an enormous chick mortality unprecedented in the Cape's colonies in both character and extent. Most of the young birds died within twenty-four hours after hatching, practically all others by the end of their second day. Since *hirundo* chicks are dry and able to run about eighteen hours after leaving the shell, it was significant that the dead young were found usually in the nests. That the mortality was not due to parental neglect or desertion was shown by adults continuing to incubate unhatched eggs in nests containing one or more dead chicks. June 22nd, when there should have been several thousand, there were at most 500 living chicks, not one seen over two days old. June 26th, following a two-day rain, even fewer chicks were found. That day the disappearance of some unhatched clutches was observed near the place where its first incidence had been noted June 12th. The three nearby rat holes had been reopened; in one of them were the partly eaten carcasses of four adult terns, but no chicks, eggs or shells. These burrows were gassed and closed. Two days later one appeared to be partly opened so it was retreated. These were the only times that repeated and thorough searches of the whole site revealed rat residence.

Population shrinkage continued with a drop to 3,000 June 28th, then to 1,000 July 2nd. The death of chicks in the manner described persisted; no live chick more than a few hours old was found on either of these two days. On July 2nd, it was found that a few of the clutches on the north end of the island had disappeared, but, as has been stated, there were no resident rats in that sector. So complete was the end result of the disruption and thwarting of this colony that only 63 chicks old enough to band were found in the whole season.

It is believed that a frustrated colony of terns always makes along fixed lines a second attempt to reproduce successfully. This had been demonstrated repeatedly preceding seasons following mishaps involving from a few birds to a whole colony. Although it was known that renesting birds do not repair to a site unless it is already at least sparsely tenanted by breeding terns, the other terneries on the immediate Cape were revisited even though they had been found to be birdless earlier in the season. Nowhere were the Tern Island *emigres* found, particularly at North Point, a location to which frustrated Tern Island birds had resorted numerous times in former years.

June 24th Plymouth was visited, a site utilized a few years ago by several thousand Tern Island birds dispossessed by extensive predation. Here were found 3,000, possibly even 5,000 birds. They were not concentrated, as in other years, on the dunes at the tip of the peninsula, for this formerly suitable terrain had been eroded and markedly deteri-

orated by the elements the two preceding winters. The terns were scattered for one and a half miles along the over-vegetated distal half of the point. Evidences of a small, earlier occupancy were found; some old scoop-holes, a small number of abandoned nests as well as a few egg shells broken in rat manner. This rodent is always present on the proximal half of Plymouth Point, invariably invading the nesting area some time during the season. That the present tern occupants of the place were recent arrivals was shown by the marked wildness of the colony as a whole, by a large number of newly made scoop-holes and by about 50 single-egged nests in that half of the tenanted area which was examined. A second visit was made to this ternery July 10th. There remained at most 500 individuals of the late June influx, far more of these on the shore lines than in the nesting area, at most 25 clutches of eggs and not one chick. In view of several similar precedents, it is believed that the large flock present June 24th were predominantly birds from Tern Island. For some unknown reason most of them did not renest at Plymouth but moved again to other rookeries.

The next site to be explored was Bird Island, June 27th. For some time this site has been occupied by a colony varying in size from 2,000 to at most 5,000 birds, one-half always being Roseate, *Sterna dougalli*. Although this flock is doubtless a member of the Cape Cod group, it has been self-sufficient and independent, but for the last three years it has been making a gradually increasing interchange of membership with the other Cape colonies. The population was found to be over 8,000, more than double what it was in 1943. Of greater significance was ascertaining that the ratio of Common Terns had risen to three or four to one Roseate. The island is small, not over five acres in extent, most of it heavily grassed leaving for use very little terrain of the type Common Terns prefer. Usually the only birds of this species found breeding on overgrown locations on the Cape, are older individuals which continue the precarious occupancy of sites they have used for a number of years, and that part of a colony which is so large that a sufficient amount of suitable territory is not available. This year nests were not only concentrated in close proximity on all the more open tracts, but they also extended in large numbers onto stretches of shingle made up of large stones and onto the surface of deep, dense mats of grass. The colony was visited again on June 29th, then a number of times later through July. In 1943, of the returns taken here, 18.7 per cent had been banded at Tern Island; this year the percentage rose to 44.1. The first two days of adult trapping here yielded six birds which had been taken earlier in the year at Tern Island including two mated pairs marked with colored celluloid bands. So it is evident that the increase in the ternery's population this year consisted of *emigres* from the Tern Island break-up. This inference is further war-

ranted by there having been no decrease in the population of other colonies to account for the Bird Island flock's doubled size. The colony had a most auspicious nesting unmarred by any mishap. It did much to make up for Tern Island's failure by yielding 2,950 chicks as well as from 1,000 to 1,500 due to hatch from the late renesting.

Nearby Ram Island duplicated the above detailed picture. Its normal population of 3,000 to 4,000 was reduced last year, for some unknown reason, to not over 1,000. This season it exceeded 8,000 when it was visited for the first time on July 3rd. Here, as at Bird Island, were found birds which had been taken earlier at Tern Island including two celluloid banded pairs. Prosperity characterized this nesting. Last year its chick yield was 282; this season it was 3,013 not including late hatchings from the extensive, late renesting.

Tern Island's disastrous first effort was not a finality. On July 2nd considerable new nesting was found at its extreme southern end. Little by little this renesting extended over the whole rookery, especially along the edge of the environmentally desirable west shore. On July 26th more than 3,000 birds were present. On July 28th, the date of our last visit, the clutches laid by these prodigals—as retrapping showed many of them to be—were still intact, incubation was being carried on but, of course, not with the intentness which characterizes either an initial nesting or one by a larger, more concentrated flock. It was not determined whether any chicks accrued from this belated effort.

From the sequence of events delineated it is evident that the Tern Island colony, as the break-up of its nesting progressed, divided into four groups. One group repaired to Bird Island and a second to Ram Island, both for eminently successful renestings. A third group went to Plymouth, remained there a short time, then departed without having started a comprehensive renesting. (Probably these are the individuals which returned to Tern Island in July, duplicating an event known to have occurred one former season. Substantiating this return is the recapture on Tern Island, late this July, of many breeding birds trapped there in May and early June.) The fourth group is composed of several thousand *emigres* which were not found in the three preceding groups.

Of the doings of this last group subsequent to the dispersal of the Tern Island colony there is no positive knowledge. It was found that they did not renest anywhere within the limits of the Cape group's territory; their having joined "foreign" colonies outside its boundaries is too incompatible with their fixed behaviour in matters of this sort to be considered. Even Penikese Island, with which the Cape group has always had a tenuous affiliation, can be ruled out for never before had Penikese and the Cape's colonies made an interchange of

renesting individuals. Without precedent, during the first ten days of July, a considerable number of terns were observed fishing and idling a few miles offshore. It was too late for these birds to be newly arrived from the wintering grounds, too early for the inception of migration southward of either Cape group birds or members of colonies nesting north of the Cape. So, it is believed they were a part of this fourth group which either had been twice frustrated or had failed to renest.

In preceding contributions by this station it has been shown that, over the years, the Cape Cod group of terns has maintained its population total at a fairly fixed level, annual variations being ironed out by adjacent seasons. The yearly failures or unusual successes of one or more of the component colonies are compensated by the yields of others. In spite of the gross abnormalities of the 1944 nesting, the Tern Island debacle in particular, the group's chick production was 41 more than it was from the relatively normal 1943 season. A comparison of the takes for the two years is shown in the following table:

	Chicks Banded	Adults Banded	Returns	Repeats	Total Takes
1943	5,962	2,573	3,408	623	12,566
1944	6,003	2,563	2,525	445	11,536
	+41	—10	—883	—178	—1,030

This 1944 nesting was characterized by only two occurrences previously unobserved in the Cape's colonies—the death at Tern Island of practically all chicks soon after hatching and the possible inability of a considerable number of frustrated individuals to renest. All other deviations from a successful normal, even the complete failure at Tern Island, were repetitions of events incident to former summers simply with variations in the magnitude of the several occurrences and in their causes. Nevertheless, the aggregates of the abnormal and of the deleterious incidents were greater than in any former year. This unusual season confirmed the belief that the behaviour pattern of the Common Tern is so advantageously developed and also so adaptable as to insure reproductive success even under grossly disadvantageous conditions.

The initial alignment of the returned birds at the end of May was simply an advance in the recent drift toward consolidation. The greater part of the Cape group's constituency had gathered and become domiciled on Tern Island. One reason for this is that the colony tenanting the site is the trunk of the genealogical tree from which all the other colonies are offshoots. While group adherence, an important behaviour trait described in former contributions, was the underlying cause of the amalgamation, the ecological desirability of this rookery

may have been the determining influence. Although on superficial observation the Common Tern appears to be slow in reacting to changes, it does recognize and utilize improvement in environment. Tern Island, as the achievement of ten years of extensively constructive care, is overwhelmingly more advantageous than any other Cape ternery and has but one major detraction—its proximity to the mainland and to the rats in the fish shacks along that shoreline. The decadence of other nesting sites had progressed without regression; Egg and Billingsgate Islands no longer exist; Nausett Point has not rebuilt since it was washed away. North Point is level sand with no trace of vegetation to afford cover for chicks; Jeremeys Point and Plymouth have lost much of their desirable terrain. Fortunately, however, Ram and Bird Islands were improved by the scourings of two recent hurricanes and possess the advantage of absolute insularity. Both were well tenanted this year.

Twice in the last decade, first at Jeremeys Point, later at Plymouth (sites continuously but sparsely tenanted for a considerable time), the population suddenly mushroomed into a successful colony numbering several thousands. The mishaps in the other colonies immediately preceding and concurrent with the development of the new ones do not account adequately for these apparently unnecessary developments, particularly because there remained at Tern, Ram and Bird Islands sufficient unoccupied terrain to accommodate the members of the new colonies. Inasmuch as the group's population continued stationary, there was no excess of young birds to call for the pioneering of new terneries. So it is inferred that there existed at the usual nesting sites some unrecognized ecological deficiencies which were immediately responsible for the shifts to new locations. Both these colonies (Jeremeys Point and Plymouth) were short-lived—about three years each. The component birds, as shown by trapping data, then consistently followed their usual behaviour trend by returning to the colonies from which they had withdrawn temporarily until the environment had become again satisfactory.

Only once before had Tern Island failed to mature several thousand chicks. In 1932 the invasion of a large number of rats at a time when the site was so much overgrown that they were afforded perfect cover, resulted in a complete destruction of the entire hatch. (Austin, O. L., Jr., Further Contributions to the Knowledge of the Cape Cod Sterninae, *Bird-Banding*, Vol. III, No. 4, October, 1932.) Partial failures had occurred there from time to time but always from obvious causes. Usually they were due to predation, but once to molestation and once to extensive chick mortality during a severe storm. However, other smaller colonies have experienced practically complete failures of undetermined etiology, notably Jeremeys Point where, repeatedly, several thousand nesters raised less than a score of chicks. Similar frus-

trations are reported to have occurred off the Cape at Penikese Island and in colonies in the region of the Great Lakes.

The Tern Island catastrophe was characterized by two major events, first the unprecedented chick mortality, second, desertion of the rookery by almost the entire colony. Although both occurrences were fairly well synchronized, in almost all instances the death of their chicks preceded desertion of the ternery by the adults. However, this sequence of the two events continued only until the daily hatchings and desertions became so great in number that the remainder of the colony grew restless and began, not only an extensive desertion of unhatched clutches, but an abandonment of the few chicks which had survived for a few days.

In the annual breeding of the Common Tern, chick mortality is always large. At Tern Island in 1939, 21.5 per cent of the hatch was buried; in 1943 it was 22.1 per cent. Both figures are a little high by reason of an inability to include in the total yield the small number which escaped banding. Usually, only a few perish during the first two days after hatching; the highest death rate is during the second week. A considerable number of more matured dead chicks continues to be found until all birds of the year have departed from the ternery. The incidence is greater in big than in small colonies, for concentration increases most of its causes. Insularity of a rookery, by eliminating rodent predation, tends to lower mortality. As a general rule, almost all chicks hatched by small numbers of renesting birds perish, especially late in the season, but paradoxically, when large, compact flocks make a second attempt, as at Bird and Ram Islands this year and at North Point and Billingsgate Island in preceding ones, the percentage of chicks surviving is more than twice what it is from initial nestings. It is believed that, in spite of the high death rate of chicks, the Common Tern will continue to maintain its population level so long as the average size of the clutches laid is not lessened. Nevertheless, it can be of serious moment if, by reason of mishaps, it is not compensated seasonally, or at least over a period of years. Chick mortality is due to a number of known causes, such as predation, violence, molestation, exposure and parental neglect; possibly to some which have not been proved as food shortage, diseases and constitutional weakness; also to others which have not been observed.

In the insular colonies, the common rat is the only predator known to victimize young chicks and its food preference for them is only slightly less than it is for unhatched eggs. Its voracious appetite means the consumption daily of more than one chick by a single resident rodent, for only small portions from the back of each victim are eaten. Its wantonness is even more destructive for always many more are killed, then either scattered around or accumulated in the burrows than

are consumed. Fortunately, owls never prey on birds of the year until the latter are able to fly, but the young of colonies nesting on either a peninsula or the mainland are often killed in considerable numbers by foxes, skunks and weasels. On several occasions the entire hatch of a good sized colony has been destroyed by these large predators.

In the course of a relatively undisturbed nesting a few chicks meet violent ends from being head-pecked by adults whose territory they have invaded repeatedly. While rare instances of it have been noted in small, diversified colonies usually it occurs to an important extent only in such large, closely occupied sites as Tern Island. Although it is the standard punishment used by parents in training their own offspring, numerous autopsies have demonstrated the lethal intracranial injuries a small amount of head pecking can inflict. It is the only violence to which chicks are known to be subjected routinely.

Once from Plymouth and once from Tern Island, setter dogs have been driven off after they had killed 40 or 50 young. In 1942 a party of juvenile vandals destroyed over 200 chicks and as many clutches at Tern Island. However, events of this sort are infrequent and their toll is of minor importance.

Exposure to the elements, excepting when predation is severe, is the most prolific extrinsic cause of chick mortality. Although in most respects the Common Tern is precocial, its ability to withstand the elements is no greater than that possessed by species bred on more sheltered terrain. In the Cape colonies the chick death rate of the conesting Roseate Tern *(Sterna dougalli)* is more than fifty per cent less than that of Common Terns simply because the clutches of the former routinely are placed well under protecting vegetation and their chicks are given far less to venturing from their nests. It is perhaps for this reason, either as the cause or the result of the behaviour, that Roseate Tern clutches are consistently smaller than are those of Common Terns. During chick banding, when a number are found huddled under a plant or a clump of grass, the Roseates are always at the very bottom of the pile. Heat, cold, high winds and protracted rains alike overtax the physical resistance of young birds depending much on the degree to which counteracting brooding is carried on by the parents. Heat is far more destructive than cold which is why a colony is always more comprehensively grounded when the temperature soars. As a rule the number of dead found after prolonged storms is more than twice that seen during a series of fine days for wet plumage lowers body temperatures and resistance.

It is an important shortcoming in the behaviour of the Common Tern that chicks do not obtain for themselves the maximum possible protection against the elements; usually it is the result of parental neglect. As holds good for most avian species, the care and protection of their

young supersedes all other inclinations of parents, even the enhancement of their own personal safety. Nevertheless, very often sufficient protection is not given to forestall the functioning of some of the immediate causes of mortality. Such inattention is brought about by human intrusion into the nesting territory with resulting interruption of an orderly pursuit of breeding activities. Feeding and brooding are halted while frightened chicks stray too far from their nests to be rescued. No colony escapes intrusion, and some, like Plymouth, are subjected to excessive amounts of it almost daily; even to camps being located and tents erected in the very heart of the nesting area. This station, in order to obviate parental neglect, has found it necessary when working in a colony, to use a blind or to leave the nesting territory frequently and for a sufficient length of time to restore peace and allow adults to give their young adequate attention. Obviously, intrusion does the most harm on very hot days. In July many dead chicks 2½ to 3 weeks old are found, almost always on the edge of the nesting territory or well beyond it, probably victims of parental neglect.

It is desired to discredit the myth of food shortage so frequently asserted to be the cause of mishaps in tern colonies—including chick mortality—when credible findings are lacking. All who have reported food shortages—including the writer—have failed to append credible, substantiating data, for it is not indicated either by the absence of schools of the preferred sand-eels from the immediate vicinity of a ternery, by finding discarded, oversized fish in the nesting area or by the surface feeding on marine invertebrates frequently observed at Tern Island. To the Common Tern, a swift and tireless flier, distance is of small moment and since the feeding and brooding of chicks is done by both parents no harm results from the absence of either one for an hour or more in the acquisition of food, or of both excepting during inclement weather. Planned observation has shown that most of the time, food is obtained between one and four miles away from the terneries. When Egg Island domiciled a large colony, the feeding ground was an inlet one and one-half miles distant. Birds from Tern Island can be seen fishing in the equally distant shallows around North Point. From the vantage point of Chatham light, midway between, lines of terns may be seen flying from the island to the point and returning with fish. The Bird and Ram Island colonies are supplied from the vicinity of the mainland one to four miles distant. Excepting those crippled or obviously sick the 200,000 adult terns we have had in our hands were always plump and well nourished; were they hungry, large numbers of adults would not idle habitually along the shoreline of rookeries. Palmer in his monograph (A Behaviour Study of the Common Tern, 1943) gives a comprehensive summary of all that has been published concerning the food of the species, and shows how varied a

selection is made from items not on the preferred list. Additional observations could be recounted to substantiate the opinion that belief in the occurrence of a food shortage is the consequence of either sophistry or conjecture.

Unfortunately, practically nothing is known concerning the occurrence of disease in tern colonies; the question is so much a *terra incognita* that any opinion in the matter is essentially theoretical. The possibility that some acquired malady kills chicks cannot be gainsaid but no incident strongly indicative of this being a fact has been observed.

The offspring of all species vary in size and vitality, siblings are not identical nor do the successive progeny of any bird duplicate each other in these respects. Accordingly, since each individual must possess when hatched a fixed minimum of hardihood in order to survive, it is axiomatic that the chick mortality in any tern colony is determined primarily by the sturdiness of its young. It is equally incontrovertible that the death rate varies both in the several colonies and seasonally in direct relation to the character, potency and number of ecological and other hindrances encountered.

When the several known causes of chick mortality are correlated with the events of this nesting, it appears that neither any one nor any combination of all account satisfactorily for the Tern Island mishap, particularly for the death of chicks in the nests. Rodent predation was trivial and of short duration. After hatching was well started the weather was continuously propitious with no extreme heat. Deaths during the one intercurrent, two day storm were only slightly more numerous than before or subsequently. The only recognized deviation from the normal ecology of the site was a moderate sparcity of vegetation. This, however, was of no moment chiefly because most of the chicks expired before shade and shelter became requisite. Intrusion was reduced to a fraction of what it had been preceding years for this station's activities were centered on special work carried on with quadrats in three small sectors. For the first time in more than a decade adult trapping did not encompass the entire island at least once. When the excessive mortality had become apparent, special observations were made to determine possible parental neglect. It was found that, in spite of the marked wildness of the colony, incubation, feeding and brooding were carried on quite as consistently as usual. Repeatedly adults were seen incubating eggs with the hatched portion of the clutches dead in the nests. July 2nd, a pair of adults were retrapped while incubating eggs in the same nests from which they had been taken May 29th. This being nearly a week more than the maximum known incubation period, the eggs were broken and found to be spoiled. Since premature hatching does not occur in class Aves, emer-

gence this year could not have been before physical development had reached its normal.

With no demonstrable cause having been found, disease comes to mind intuitively as being an apt, explanatory source of the anomalous chick mortality. Nothing substantiating this can be offered excepting its plausibility while there are no cogent arguments against it. Hereditary disease is ruled out for being contrary to present day tenets; there is no known malady to which parents might have failed to transmit to their offspring the usual immunity. Any sickness acquired after hatching must have been endemic on Tern Island for no similar chick mortality occurred in any other ternery. Also it would have affected some of the adults and that was not the fact. Incidentally, the adult death rate at Tern Island this season, 1945, was within normal limits. At times, pathogenic organisms do become temporarily exceedingly more virulent. If tern chicks always experience a mild form of an ailment which, this year, became deadly, in view of the constant interchange of membership by the colonies not only would the incidence have been widespread in the Cape group but also, as is more significant, it would have persisted throughout the renesting.

It is possible, but visionary, that the Tern Island chicks, necessarily as a unit, this year possessed a much reduced physical inheritance. If this were true, the affliction would not have been visited on a single colony. Further, the second seasonal broods of the same parents should have fared at least quite as badly if not even more grievously.

Unless the occurrences incident to this season's nesting were not observed accurately and the various sources of chick mortality correctly evaluated, the real cause of the fatalities must remain unknown. This and other unexplained events have suggested repeatedly that there exist, unrecognized, important ecological desiderata which are the determining factors in some items of behaviour.

The disintegration of the Tern Island colony with dispersal of its component members was so closely correlated in incidence and progress with the chick mortality that both events would appear to have been of common origin. In former contributions it was postulated that mass site desertion results only from one or both of two mishaps—predation and frustration. The former, this year, was too insignificant in amount to have been causative but the latter began with the first hatchings and increased so rapidly that it promptly involved the greater part of the colony. Therefore the correct inference is that chick mortality was the essential cause of the Tern Island rout. Once started, it was patterned by behaviour trends and terminated with the extensive desertion of clutches in which embryonic development was found to be well advanced.

The predominant traits in the behaviour of the Common Tern from

the standpoint of their value in enhancing the welfare of this species are, in the order of their relative effectiveness, colonial nesting, group adherence, site tenacity, reaction to predation or frustration and renesting. Not only do all five work cooperatively but they also modify each other to the degree made necessary by the constantly changing events of a nesting. This is of importance because tern behaviour is far more a matter of habit than one of conscious cerebration. All have been defined in former contributions and their functioning under ordinary and some abnormal conditions have been described.

Group adherence is simply a corollary of colonial nesting, both trends probably having developed concurrently. So closely are they correlated that it cannot be postulated whether or not, and if so which anticipated the other. At present this type of nesting is more essential than is the preservation of the same membership in flocks; so, naturally, it has assumed dominance during the breeding season. However, group adherence continues to be of great importance to the welfare of the species for it has been found that reproductive success, when averaged for a decade with due allowance being made for inevitable variables, increases in proportion to the degree to which the Cape group's total membership is concentrated in the colonies. Likewise, when extensive renesting becomes necessary the better gregariousness is maintained, the more advantageously are the birds relocated on secondary sites. Recently this habit, stimulated by the disappearance or deterioration of several excellent rookeries, has effected a progressive concentration of the Cape group's birds into fewer and larger colonies. It culminated, this year, in the convergence to Tern Island of about two-thirds of the population. Although, as it turned out, this concentration was responsible in the initial nesting for a great elevation of the percentage of chick mortality, ultimately the trend which led to the concentration accomplished a satisfactory seasonal chick yield. In view of the known failure of small colonies to raise chicks in the same ratio to the number of breeding adults present as large ones do, had Tern, Ram and Bird Islands been tenanted in either the first or second nestings by their usual populations and the remainder of the group's components scattered through lesser terneries, the total chick yield would have been much smaller. Group adherence obviated this by amalgamating into a few large flocks the completely frustrated Tern Island birds and relocating each in another big colony. Leadership and flock dominance played a very small, if any, role in the procedure for, other than older birds being first to nest and most consistent in site tenacity, there is nothing to suggest the existence of class distinction in tern colonies.

It must not be inferred that all members of the Tern Island colony were clearly orientated concerning misfortune which either had happened or threatened. When a sufficient portion of the colony had been

frustrated to make concerted readjustment necessary, most behaviour trends, even loyalty to clutches suffered unreasoned subjugation to an urge to maintain the colonies alignment when renesting followed in other terneries. It might be argued that concerted action is a simpler and equally credible explanation. In rebuttal is the fact that this is of rare occurrence in tern behaviour (Austin, *Bird-Banding*, Vol. XVI, No. 1, January, 1945, p. 25) and takes place only in a ternery itself or the immediate vicinity. Preseasonal and postseasonal migration as well as intraseasonal membership changes in the colonies are carried on by small flocks of a few individuals. The Tern Island expatriates were reunited at Bird and Ram Islands by the same mental processes which reunite returning birds in the Cape's colonies each May. The above, together with no other unnarrated interpretations of the season's events appear to suggest that group adherence is too firmly established a habit to be deviated from even under unusual circumstances.

Perhaps the most convincing evidence of the existence and potency of group adherence is an analysis of the captures of what this station designates "foreign birds"—individuals banded outside the Cape group's territory. Unfortunately, very little adult trapping is done elsewhere to indicate the number of Cape banded birds nesting in foreign colonies. The Fish and Wildlife Service files show that only eighteen Cape banded birds ever have been taken elsewhere in the United States during the breeding season; only five of these in nesting colonies. One was found dead at Brant Beach, New Jersey, July 13th, 1936, four were taken at Weepecket Island, Gosnold, Mass. Between 1938 and 1944 inclusive a total of only 55 birds banded elsewhere have been taken on the Cape, the average being 7.1 for a year; 9 of the 55 came from the Great Lakes region. Not included is the average annual capture of 24 birds banded at Penikese Island, almost all of them being trapped at Ram Island, Bird Island and Plymouth which are close to Penikese Island. That colony, definitely, is not a member of the Cape Cod group, also the number from that ternery taken yearly is too large to suggest their having become affiliated in the manner usual for foreign birds—mating on the wintering grounds. The 55 birds constitute a mere 0.0023 per cent of the total returns and recoveries in the seven-year period. From 0.0011 per cent in 1938 it increased gradually to 0.0059 in 1943 but dropped to 0.0028 this year with the capture of the average seven individuals.

A first, casual opinion might be that the trait termed site adherence exerted small influence on this season's events; quite to the contrary, if its essential characteristic rather than its minor details is considered, it is seen to have contributed more than it usually does toward fashioning a nesting. Its essence is not the return of a bird to the exact spot of its former tenure but rather an individual's utilization of nesting sites

in exact relation to the degree of its former associations with them. Subservient to more powerful trends and especially sensitive to ecological changes, it functions far better in governing the action of flocks than of a single bird. A large majority of the Cape's Common Terns were hatched at Tern Island and subsequently have nested there. Also, as their records show, a considerable percentage of the terns hatched elsewhere have located or renested at Tern Island at least once in their lifetime. This is one of the reasons for the unusually large congregation at this rookery in early May. That the majority of the Tern Island birds chose Ram and Bird Islands for renesting does not indicate an overestimation of the influence of this trend. North Point and Plymouth, from the standpoint of previous attachment, were the logical first choice for many times large aggregations from Tern Island had resorted to these sites. Several thousand did go to Plymouth at once even though they did not stay there. Obviously environmental conditions at Plymouth and North Point were too unfavorable to warrant their occupancy.

There is seldom a year when, from one cause or another, the chick mortality incident to the first nesting of one or several of the colonies does not exceed greatly its normal rate. Were this not offset there would result, necessarily, a progressive shrinkage in the group's total population. The simple expedient of renesting precludes this adequately. Fostered by repeated frustrations, renesting has developed into a fixed habit free from known inhibitions. While it is impossible to determine the doings of every breeding adult throughout a season, the consistent repetition of many suggestive incidents have led to the opinion that practically all thwarted Common Terns make a second seasonal attempt to raise chicks. Newly laid clutches are found even late in July when the chance of chick survival is negligible. That second clutches usually are laid within a week after failure shows that this trend is anything but a dormant trait. This year, the Tern Island failure would have resulted in a serious minimization of the Cape group's chick yield had not a prompt, extensive and advantageously fashioned renesting obviated it most successfully. In a preceding paragraph a suspicion was expressed that several thousand members of the dispersed Tern Island colony failed to renest. If this is a fact, it is believed that the occurrence was due to a transient physical incapacity and not to any lessening of the urge to renest. Never before had a similar event been observed in the Cape's colonies.

Realization of thwarting is prerequisite to any subsequent readjustment to it. Luckily, frustration is one of the few occurrences which terns appear to recognize and evaluate promptly. Mental keenness is not characteristic of this species, and memory appears too frequently to be short lived. For example, the same birds continue to lay eggs year after year where always they are washed away by the first spring

tide which follows. How prompt and comprehensive reaction is to failure, depends on the number of birds involved, for reaction grows geometrically as the number of birds involved increases. Rat predation is the particular mishap to which a colony takes prompt and extensive counteraction, probably because it so rapidly defeats the purpose of most of the membership. It is reasoned that this year's almost complete emigration from Tern Island was due to the speedy frustration of almost the entire population.

The assumption of territory and the protection of its tenure occurs to a varying degree in all colonies of nesting Common Terns but it is a far less dominating trait than ornithologists have found it to be for many other species. In the organization of a ternery, the older as well as the more consistently returned birds first choose nest sites, usually in the immediate vicinity of their preceding holdings. No fixed amount of terrain is required by individuals and those nesting later are permitted to locate between the preempted sites. The degree of concentration and the proximity of nests are determined by the number of individuals present, the amount of land available and especially by the ecological desirability of its sectors. During this formative period there appears to be little if any resentment of intrusion, but once the colony is well domiciled, and especially after complete clutches have been laid, trespass is not tolerated. Further, this behaviour increases markedly when chicks have replaced the eggs. This applies far more to large, compactly nested colonies than to others where the nests are scattered widely. No credible reason for this assumption of territorial rights has been discovered. Food supply is no factor. Contrary to Pettingill's experience with Arctic Terns (History of One Hundred Nests of Arctic Tern, The *Auk*, Vol. 56, October, 1939) the destruction or stealing of eggs by Common Terns has not been observed in the Cape's colonies. The only times when three adults have been taken from one nest have been when an adjoining nest was so close the trap could have fallen easily on occupants of both. The welfare of chicks plays no part, for so persistently do they leave the parental domain that, evidently, they are unaware of the existence of its boundaries. Accordingly it is probable that the assumption and protection of territory is simply an unnecessary continuation of a habit of untraced origin. The correctness of this concept is further suggested by the readiness with which this behaviour trait is abrogated. At the time when the disruption of the Tern Island colony was well started, Bird Island was thoroughly occupied by its usual tenants, all the desirable tracts were closely nested and extensive egg laying had been done elsewhere. Hatching had begun there even before the emigration from Tern Island had reached its peak. In spite of this, over a period of about ten days, the colony doubled its size by giving sanctuary to several thousand renesting birds from Tern Island. Certainly even a

moderate functioning of the behaviour trait under discussion would have prevented this unusual invasion.

The foregoing appears to indicate that the Common Tern is not over-specialized, not even highly specialized and that its advantageously developed behaviour pattern although characterized by several strong traits, remains sufficiently pliable to successfully cope with unusual adversities of dangerous magnitude. Assuredly the evaluation of any behaviour pattern should be from the standpoint of its ability to maintain a species' population at a safe level regardless of any depletions which may occur. This, the Cape Cod group was able to do in its 1944 nesting by resorting to one potent behaviour trend and modifying all others in ways best suited to assist in its consummation.

North Eastham, Cape Cod, Massachusetts.

NAMES OF AGE GROUPS OF YOUNG BIRDS

By Harold B. Wood

A uniformity in the terminology of age groups of young birds has always been desirable. Several terms have long been used to denote the approximate ages of young birds, and have been so confusing and overlapping that some have been adopted where they clearly do not belong. These terms are nestling, fledgling, juvenile, immature and young. The word nestling dates back to 1399, juvenile was used by Bacon in 1625, and the fledgling bird was sung by Tennyson in 1830. These different age groups vary in length, respectively, from a few days, to some weeks, to several months, and to from one to three or more years, depending upon the species. This nomenclature of age groups has long concerned ornithologists, who can and should coordinate their ideas into the adoption of systematized definitions. These are essential but for two entirely different purposes, for ageing banded birds and for museum specimens. Whereas the bird bander must judge by the single specimen in hand, the preparator of bird skins has cranial or other anatomic characteristics and comparable plumage specimens to aid in his identifications. The appearance of the plumage, its stage of development and coloration are the principal factors upon which the judgment for classification must depend for banders. Other developmental characters include such items as the color of the iris or markings about the bill, but the bander may have difficulty in determining the condition of the fontanel. While for the collected specimen it may be desirable to note the stage of molting in transition, with banded birds it is only necessary to make a record as of a completed molt. The

bander needs brief abbreviations of the age terms, *e.g.*: "*nest.*," "*fl.*," "*juv.*," "*imm.*," or similar notations.

Although the banding of nestlings has been deemed undesirable as a widespread proposition, when banded for special studies or as of rare or rarely obtained birds, it should be recorded definitely that they are nestlings, because their hatch is known within a few days. Likewise, when birds recently out of the nest are banded, and are subjected to an excessive mortality rate from predators or other causes, their recordings should show a definite age group (fledgling) and not both these classes be merely recorded as "young."

The desirability of a uniformity in the use of these terms may be appreciated by referring to a few ambiguous expressions which have come recently to my attention. A popular magazine recently stated, "The parent birds brought live mice to the nest and fed the fledglings." Another described, "Fledgling Bluebirds buried under the nesting material." One author stated a fledgling is "from the time the bird is completely feathered until nearly full grown." Contrast that with the development of the Bald Eagle. A prominent bird bander recently described a "juvenal" as "a bird banded in the nest or caught after leaving"; and a young bird as "after the fall molt, hatched that year." A well-known author stated, "Juveniles can be divided into nestlings and fledglings, that is those taken in the nest and those taken out of the nest." Another admitted, "I have been troubled about our terminology," but he further declared, "In my banded birds I report 'Juv.' for birds banded in the nest, and 'imm.' for birds known or believed to be birds of the year." These usages are very misleading and not in accord with ornithological knowledge.

Also, other expressions by ornithologists showing confused ideas were: "One immature bird was captured two days after leaving the nest"; "grouse are called juvenile until the outer primaries develop as adults"; the term "nestling" being applied to the young after leaving the nest; a fledgling—"from the time the bird is completely feathered until nearly full grown"; "full grown juvenile"; "a female Swainson's Warbler was caring for two juvenile birds (about five days out of the nest)".

Dictionaries, so universally sought for correct definitions, attempt to give acceptable definitions of words, but are not always abreast of science, nor in mutual agreement. A nestling is described as "a young bird which has not abandoned the nest" (Webster), or "not old enough to leave the nest" (New English). John Walker's Dictionary of 1807 defined a nestling as "a bird taken out of the nest." A fledgling—a word actually meaning ready to fly—is accepted as a "young bird just fledged or feathered"; "equipped or ready to fly"; but only one dictionary, an edition of Webster's, gives the definition as "covered with

feathers or down." These are contradictory, as a downy altricial bird is not ready to fly and a downy precocial is ready to leave the nest. Zell's Encyclopedia of 1870 succinctly describes a fledgling as "qualified to leave the nest." Webster's quotes Dwight on juvenal plumage, "The plumage of a bird immediately succeeding the natal down" —which is the feathering of a fledgling. The word "juvenile" appears in John Walker's Dictionary of 1807 and quotes two pronunciations, with short and long "i", with personal preference for the latter.

Jonathan Dwight, writing of Passerine birds, separated them by age according to plumage development and subsequent molts. The stages of plumage development he termed the natal, juvenal, first winter, first nuptial, second or adult winter, and second or adult nuptial. He wrote, "Unfortunately we have no other available guide except plumage to determine whether a bird is one, two or more years old," which is quite true, and most useful to know when studying a series of bird skins. His classifications did not take into account anything of the life ability of the young bird to manage its own affairs—a most critical period. Dwight believed the term "juvenal" should apply to the first plumage, that of the fledgling; thus the juvenal plumage covers the fledgling and the juvenile, and includes the spotted breasts which later become a clear color. Dwight further wrote: "In some species the plumage following the juvenal may be indistinguishable from that of the adult, in others the adult dress may be assumed just before the first breeding season, and still others not until after this season." Since adult means sexually competent, there is no way for a bander to determine if these adult appearing birds are adult unless they are sexually active.

Because ornithologists should select or approve definite terms of nomenclature, letters with suggestive definitions, different from those accompanying this article, were addressed to several leading ornithologists, and their replies may be quoted.

John W. Aldrich was quite in agreement with the definitions as submitted. Herbert Friedmann thought them adequate. Arthur A. Allen worded them differently. Ernst Mayr wrote: "Questions of terminology are always thorny, particularly when of one field are transferred to another. In your case, the terminology for the various plumages was originally given to plumage stages of bird skins. For these workers the plumage alone is the decisive factor and it makes no difference whether or not the young bird has left the nest. Further complication is that your terminology applies only to altricial birds and furthermore only to those which do not have a complete fall molt." The definitions he referred to are not those given in this article. Lawrence E. Hicks said he used precisely the same definitions as given except for "young"—"which I have arbitrarily defined as offspring

in natal year up to January first, or in their first year as long as distinguishable from adults. In the southern hemisphere the arbitrary date would be different—so your one year is probably better than any."

Alden H. Miller states that birds of the year "would be classed either as juvenile or immature according to whether they had undergone the post-juvenal molt." Also, "The term immature is correctly used even for a bird that has a plumage indistinguishable from an adult if it shows other definite signs of youth, specifically in the skull region where ossification may be incomplete." This osteologic point cannot be determined by bird banders, hence the plumage alone must be the differential limit, as according to Dwight. James L. Peters further elucidates, "I find it unsatisfactory to age birds in New England on cranial characters much after December first. By that time the fontanels in the skulls of the birds of the year are completely ossified, as in the adults, and I doubt if in banding purposes it would be possible to make any age determinations." Frederick C. Lincoln wrote: "To me the terms fledgling and nestling are synonymous with juvenile, and I never use them except in that sense. In other words, I use the term juvenile (abbreviated juv.) for any young bird from the time it is hatched until it is definitely on its own, when it becomes an immature (im.). This status it retains as long as it shows by its plumage that it is not an adult (abbreviated ad.). In my opinion these three terms all involve very definite periods in the life of a bird, and generally there is no difficulty in applying them." W. E. Clyde Todd, in labeling specimens, uses the word juvenile to include the first three classes, but agrees that "some distinction might very well be drawn."

John T. Zimmer reached the conclusion that he does not believe that the application of so many common English names can be restricted to particular stages in a young bird's existence. He stated juvenile, immature and young are distinctly overlapping in their meanings. Dr. Zimmer wrote: "I think a better system would be one based on plumages which are matters of age and development, regardless of whether the bird is precocious or not. In this country Dwight's terms are quite adequate, and most people use them." Frank M. Chapman wrote: "I should turn first to Dwight's Molts and Plumages and possibly amend them as required, rather than develop a new nomenclature." The sole purpose of this paper is to clarify the nomenclature already set up, not to propose a new one.

FLEDGLING PERIOD—This expression is confusing and used variously. As the hatching period terminates with the appearance of the hatch, so the fledgling period might be stated to end with the development of the fledged bird, and would therefore represent the life span of the nestling. Stresemann used the term as that time spent in the nest. R. E. and W. M. Moreau stated: "It is misleading to take as a rule the

day the young bird leaves the nest as the end of the fledgling period; it is preferable to take, as far as possible, the date on which the bird can raise itself in the air by its wings." Many birds would not fit into that category. B. H. Ryves suggests the fledgling period be defined as "the period during which the young remain in the nest, which they finally abandon under natural conditions, in varying stages of general development." Alden H. Miller uses the expression to include only the life of the fledgling, out of the nest, as does Dr. Friedmann. This use seems much more logical and makes this period analogous to the childhood period.

NESTLING—Alexander F. Skutch correctly terms the nestling as the bird "between hatching and its departure from the nest." Witherby describes the period as "from hatching to the growth of the teleoptiles," the down or feathers which succeed the neossoptiles. Arthur A. Allen suggested, "A young bird in the nest, not fully feathered and with apteria still prominent," which is inclusive of many species. Since some birds are hatched with no down and others are completely covered with it after leaving the nest, the definition in Funk & Wagnall's 1941 College Standard Dictionary is all inclusive: "A bird too young to leave the nest."

FLEDGLING—"A bird which has left the nest but is still dependent on its parents," suggests Mrs. Margaret M. Nice. This is a better definition than the etymology of the word compasses. All dictionaries describe the bird as "fully feathered," but Webster's Students' Dictionary includes "downy"—which would include precocial birds, as quail, rails and others. Alden H. Miller, evidently writing of atricial birds, defined the fledgling as "fully feathered young bird which is under the care of its parents, and is either out of the nest or is ready and able to leave the nest." Herbert Friedmann would restrict the term fledgling to "birds already out of the nest but still cared for by the parents." It is difficult to decide when the fledgling stage is passed, or when a parent bird stops feeding its young. I have seen young Killdeer exactly the size and appearance of adults being fed parentally. Dwight used the words "juvenal plumage" as developing after the post-natal molt, which would be the plumage of the fledgling continued into the juvenile bird. The succinct expression in Zell's Encyclopedia, 1870, is developmentally correct: "Qualified to leave the nest."

"The word 'chick,'" wrote Mr. Lincoln, "I think can be rather generally applied to the downy young of precocial birds, although it is rarely if ever used for ducklings. Nevertheless, for all of these I think that the term juvenile is preferable."

JUVENILE—H. F. Witherby states a juvenile is "a bird in its first covering of true feathers, which usually immediately succeeds the down of nestlings." Dwight classes the juvenile as between the post-

natal molt (of down) and the post-juvenal molt, doubtless meaning the completion of each. "The juvenal plumage [is] acquired by a complete post-natal molt." Mr. Lincoln grossly applies the term to all young birds from hatching to weaning, for the entire time they require the care of their parents. Mr. Todd labels specimens as "juv" to include all birds up to the post-juvenal molt, but agrees that some distinction might be drawn. When these birds are in the process of the post-juvenal molt, Mr. Peters sometimes designates them as "juv-imm." Mrs. Nice wrote: "Some warblers might not be juvenile at all, as they acquire full plumage while still dependent—at least that was my experience in Massachusetts." The title used by Dwight of post-juvenal molt definitely terminates the juvenile age group.

IMMATURE—The period of the immature bird begins with the completion of the post-juvenal molt and terminates with the acquisition of full adult plumage. Dr. Miller separates the juveniles from the immatures by the post-juvenal molt. Mr. Todd restricts the use of the term "immature" to individuals which have assumed the first winter plumage, at least as long as they retain an incompletely ossified skull.

YOUNG—The broad distinction classes birds as either young or adult, but since some species require a matter of years to attain full adult plumage it is advisable to confine the use of the term "young" to those birds of the first year, preferably to those not completing the first fall, or post-juvenal molt. Arthur A. Allen says the term "young is so indefinite it ought to be avoided in banding so far as possible," but as a definition of any bird less than a year old it would be satisfactory. Dr. Friedmann stated, "the term young could be used as an inclusive term under which nestling, fledgling, juvenile and immature represent four distinct stages. I would suggest that observations of birds be written up as free as possible of the use of the word young." When used, he writes, it would give the impression that the writer was without definite information as to the bird in question.

In view of the various expressed opinions cited, and other study, the following definitions of age groups of young birds, to include the altricial and precocious birds, are herewith submitted:—

NESTLING—A young bird within and not ready to leave the nest.

FLEDGLING—Normally ready or physically able to leave the nest and survive, and still being cared for by its parents.

JUVENILE—A young bird out of the nest and able to take care of itself, but which has not completed the post-juvenal molt.

IMMATURE—A bird after completing the post-juvenal molt, but has not acquired the complete adult plumage.

YOUNG—A generalized term applied to the bird less than one year old, when a more definite determination of age cannot be made.

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A METHOD OF DETERMINING THE AGE OF LIVE PASSERINE BIRDS

By ALDEN H. MILLER

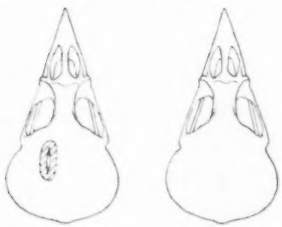
Frequently, in utilizing passerine birds for experimentation or in following their history in banding studies, it is important to know the age of individuals. In the majority of species differential plumage characteristics of first-year and adult birds are not distinct enough to afford dependable criteria. Even where appreciable differences do exist, adequate analysis of them may not have been made, or it may be infeasible for the worker accurately to evaluate them at his field station. Another method helpful in some species has recently been put into practice with fully satisfactory results. It utilizes in the live bird the condition of the skull, a criterion well known to experienced preparators of bird skins.

The skull of a passerine bird when it leaves the nest is made up of a single layer of bone in the area overlying the brain; at least, the covering appears single when viewed macroscopically. Later the brain case becomes double-layered, the outer layer being separated from the inner layer by an air space across which extend numerous small columns of bone. It is not necessary to section the bone to determine the condition. Externally the skull of the immature bird appears uniform and pinkish in live or freshly-killed specimens. The skull of the adult is whitish, due to the air space, and also it is finely speckled as a result of the dense white bony columns between the layers.

As is well known, the double condition is attained progressively and, in some species, more rapidly than in others. In some non-oscine families, as the Furnariidae, I think doubling may never be complete; and some specialized types, like the crossbills, have aberrant structure.

In a normal passerine, double areas appear first about the occipital and auditory regions and at the margins of the orbits. These areas enlarge and usually the last remnants of the single-layered state persist on the crown on a line connecting the auditory openings. Obviously only the positive evidence of a single-layered condition is significant. A double-layered skull may be that of a second-year bird or merely that of a precocial individual in its first year of life. However, in many passerine species in the north temperate region one may rely on evidences of immaturity persisting in the skull through September and October. Often they may be detected later. Experience must be gained separately with each species in order fully to evaluate the evidence.

With the live bird, a minor and essentially innocuous operation is performed to bare a small area of the skull. Lack of muscles and the extremely thin skin of the crown, with its slight blood supply, makes this feasible. Feathers are plucked from a space about 5 mm. long and 3 mm. wide extending backward from a line connecting the posterior margins of the orbits. This should be made to one side or the other of the mid-line. With the surrounding feathers pressed back, a longitudinal cut 3 mm. long is made in the skin with a razor blade or scalpel. Usually little or no bleeding results if the midline is avoided. A slight spreading of the incision with forceps enables one to view the skull and at once to evaluate its age. The skin of the head is loose enough so that the opening may be moved about and a considerable area of the skull thus inspected through the window if this is necessary to determine the condition. Occasional blood droplets that appear may be removed with absorbent cotton. After the inspection, edges of the cut are pressed together and a drop of 20 per cent celloidin is spread along the cut and allowed to dry for a few seconds, forming a seal. Healing is well advanced within two days and the skin is fully repaired in a matter of a couple of weeks. No post-operative care is necessary.



Left: outline of skull of Golden-crowned Sparrow (No. 7297, Mus. Vert. Zool.) showing location of plucked area (cross-hatched) and of cut made in skin to enable age determination.

Right: same skull showing single-layered areas surrounded by dotted, double-layered areas, a pattern typical of an immature bird taken in October.

This method has been employed with a group of twenty Golden-crowned Sparrows *(Zonotrichia coronata)* held in an aviary to determine the complicated sequence of changes in crown pattern correlated with age. Individuals taken in October display strong age contrasts in skull condition. The crown feathering was so little disturbed by the procedure that upon immediate release in the aviary the alteration of the smooth contour of head feathering was scarcely noticeable. No scratching of the celloidin seal ensued. The birds showed little excitement during the inspection. Apparently the most disturbing action is the plucking of the crown feathers. After that the birds are quiet. The actual operation would seem to be less severe than blood-bank procedures, with which many persons are now intimately familiar. The skull operation, after a little practice, takes less than two minutes. It is not nearly as disfiguring, even temporarily, as the frontal injuries which many birds receive in the course of ordinary banding activity, and there are not the associated dangers of concussion and tumor growth.

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GENERAL NOTES

Two Starlings banded as nestlings returned to their birthplace.—One young Starling *(Sturnus v. vulgaris)* No. 40-221124, banded in the nest on May 23, 1942, at the Quebec Zoological Garden, Charlesbourg, Quebec, Canada, was found dead on June 9, 1944, shortly after it had been killed by foxes in an enclosure at the Zoo, some 200 feet from its birthplace. The bird was eating meat scraps inside the enclosure when killed.

Another nestling, No. 40-221132, banded on May 23, 1942, from a nest in a 56-room bird house at the Quebec Zoo was caught in a room of the same bird house on May 21, 1945, when he was feeding a brood of four young. This Starling had been color banded, and through previous observations had been found to be a male.

Twenty-eight young Starlings were banded in 1941 and 41 in 1942 in that bird house, but the young from the broods of 1943 and 1944 were not banded. Breeding adults were not trapped in the house previous to the summer of 1945 when 57 adult Starlings were banded. From that number, only one "return" was recorded and it was No. 40-221132.

No attempt has been made to trap and band the Starlings breeding in the vicinity of that colony. Raymond Cayouette, La Société Zoologique de Québec, Charlesbourg, Québec, Canada.

Catbird Age and Return Records.—In the past decade, *Bird-Banding* has published reports on the banding of Catbirds *(Dumetella carolinensis)* in North Carolina, New Jersey, New York, and Pennsylvania (1935, M. A. Boggs, 6: 134; 1939, W. R. Batezel, 10(3): 124; 1940, G. Gill, 11(1): 21-22; 1944, H. Groskin, 15(4): 160 and 1945, 16(3): 106).

At Nashville, Tennessee, Catbirds appear about mid-April and remain into

October. During the thirteen years between August, 1931, and August, 1944, I have banded 369 Catbirds at my home station. My earliest spring trapping records occurred on April 16 in 1941 and 1945; the latest autumn capture was made November 8, 1935, the only record after October 16.

Forty individuals, 10.8 per cent of the total number banded, returned in subsequent years, 35 as station recaptures; the other five were found dead or trapped at substations within two miles of the home station. Of the 39 banded in the nest, only one returned, 2.5 per cent of the nestlings; 115 banded in immature plumage yielded six returns, or 5.2 per cent of that number; and of 215 adults, 33 or 15.3 per cent returned. There is a possibility of a slight error in figuring adult and immature percentages since there were a few banded after the autumn molt when age was not discernible.

Comparing these Tennessee Catbird returns for a thirteen year period with those of Geoffrey Gill, New York, for a ten year period, we find a similar trend in ratios although, within a shorter period, he had banded a much greater number, 1134, with return records for 99 individuals (8.7 per cent). Of his 66 nestlings, only one (1.5 per cent) returned; his 579 immatures yielded 35 (6 per cent) returns; his 489 adults yielded 63 (12.87 per cent) returns.

Gill found that most of those banded as adults returned in spring but most of the 35 returning immatures did not appear in his traps until August or September, pointing to a breeding territory some distance from the place of banding. Among the six Tennessee immatures returning, only one was a September return, the others appearing in April, May, or June.

Among the 39 nestlings at Nashville, seven were taken in traps for a total of 19 times, indicating three were near their birthplace a month later, three for about two months, and one for three months. One, banded June 2, was found in adult plumage on September 4; one, banded July 16, when trapped September 2, was recorded as immature.

Known ages for birds banded as immatures are three of two years and one of four years. Among those banded as adults, 15-18 are known to have reached two years of age; 4 birds, three years; 7 birds, four years; 2 birds, five years; 1 bird, six years; 1 bird, seven years. The predilection of these older birds is to return in consecutive years usually in the same month each season. Among those returning annually are 3 each of the three-year-olds and four-year-olds, the 2 five-year-olds and both the six and seven-year-old individuals.

There are no recovery records to indicate the winter home or migration routes of any Nashville Catbirds.

In the Catbird papers previously mentioned, a number of longevity records have been published: New Jersey (Beecher S. Bowdish), nine years; North Carolina (Boggs), seven years (2 birds); Pennsylvania (Groskin), six years; New York (Gill) five years (2 birds). Amelia R. Laskey, Graybar Lane, Nashville 4, Tenn.

A Nine-Year-Old Mockingbird and his Mates.—A male Mockingbird (*Mimus polyglottos*), banded October 1, 1936, as a first-year bird, lived in the vicinity of my home until his disappearance about May 15, 1945. During that period, he was trapped 66 times. He and his mates were color-banded, facilitating a fairly complete biographical record. He had four successive mates and, during a four-week period in 1939, an extra mate, both females occupying nests simultaneously, assisted in nest-building and guarded by the male (1941. *Migrant* 12(4): 65-67).

Until the spring of 1939, he and his current mate occupied the ground about our house for both winter and summer territory. After that, his mates chose to nest on grounds of three different residences, 50 to 100 yards from our window feeding ledge. However, they came regularly for raisins for themselves and for the nestlings, leading the fledglings to the raisins for feedings. Thus, although nests outside the banding station could not be followed as closely as in the early

years, it was always possible to ascertain the number of successful nests each season and the number of nestlings surviving.

Each autumn, "Abe," as he was called, zealously guarded his winter territory on the front section of our property which he and his current mate would occupy until her disappearance during winter or until nesting started elsewhere. The exceptional season when Abe did not appear at our home, October, 1943, until April, 1944, is inexplicable but there is considerable evidence that he had not left the neighborhood. His mate "Bab" visited the feeding shelf occasionally but did not tarry, for the territory was occupied by another male during that winter.

Although, in the environs of Nashville, I have noted occasional pairs of Mockingbirds occupying winter territory together, Abe is the only male at my home whose mates remained with him throughout the year. During the thirteen years that I have been observing many color-banded pairs, only two other pairs were found who re-mated in consecutive years but they separated in autumn. The "B" pair re-mated for three seasons but during winter they occupied adjacent territories, keeping within their individual boundaries until his spring singing started; then pair formation took place and they occupied both territories together. In the "Y" pair, a migration of the female was indicated. She left in autumn; the male occupied the territory alone but was rejoined in April by the female. Her very clean plumage, in contrast to the dark, sooty plumage of wintering individuals proved she had spent the winter outside the environs of Nashville. (1935 *Auk* 52(4): 370-381) (1936 *Wilson Bull.* 48(4): 241-255). It seems remarkable that all of Abe's mates remained with him through the non-breeding season. I was unable to discern any behaviour traits peculiar to him that might modify the usual custom in the species of pair separation at the close of the nesting season.

During Abe's nine nesting seasons, 49 young, by three mates, were raised most of which are known to have reached independence. His first mate, AYBf, joined him on March 23, 1937. Their first brood of four, when almost ready to leave the nest on May 15, was eaten by a cat. For the rest of the season, there was no evidence of a successful nest. The female disappeared during the winter. His second mate, AYR, came to his territory on February 21, 1938. They had four successful nests, all located within an area of 9 by 36 yards on our front lawn. From 16 eggs, 13 young left the nests (Review, 1939 *Bird-Banding* 10(1): 49). AYR was his mate again in 1939 but she nested diagonally across the road in a foundation planting of evergreens. From two of her four nesting attempts, five young matured to leave the nest. That year, during the latter half of April and the first part of May, Abe acquired an extra mate. The unbanded female had her nest on our front lawn while the second attempt of AYR was in progress across the road, but both nests were robbed within a two-day period when AYR's young were a few days old and the unbanded female's eggs were ready to hatch. The latter disappeared (1941 *Migrant* 12(4): 65-67). AYR remained but was not seen again after late December, 1939.

Abe's third mate was RAB who joined him March 6, 1940. They had two successful nests, raising 4 young. She disappeared about February 26, 1941, and on April 3 of that year BAB (called Bab) became his mate.

Bab survives Abe. Her own history is of considerable interest for at his disappearance in mid-May she was incubating or had very small young. She successfully raised two of them alone, bringing them to the feeding shelf when they were nearly independent. She disappeared when her young became self sustaining but it became evident later that she acquired a mate for on August 14, 1945, she brought a large youngster to the feeding shelf which she fed a few days. This autumn (1945) she is defending Abe's old territory on our front lawn where, through October and thus far into November, she has been proclaiming ownership by loud, intermittent singing each day.

In 1941, Bab's first year as Abe's mate, they had three successful nests and nine fledglings. During the four successive seasons, eight fledged from three nests in

1942; four from two nests in 1943; three from two nests in 1944, and three from two nests in the first part of the 1945 season. Because Bab chose to nest on private property, it was not always possible to follow each attempt, hence these data include only the successful nests and in some cases, are based solely on the number of young brought to the feeding shelf (a regular habit of the pair). Abe took charge of the young when his mate proceeded with another nesting but, with the last brood of a season, Bab assumed all or a good share of the feeding of the young after they left the nest. Abe was, throughout his life, a solicitous parent and zealous in care of the young.—Amelia R. Laskey, Graybar Lane, Nashville 4, Tennessee.

One-Eyed Robin Returns Three Seasons.—Banded No. 217184 on October 6, 1941, at my home in Nashville, Tennessee, a male Robin *(Turdus migratorius)* made an unusual survival record despite the handicap of losing his right eye. He appeared normal when banded but when retrapped two years later as a return —1 on April 27, 1943, it was obvious that vision in the right eye was impaired or entirely lost, the eyeball showing signs of injury. He returned February 3, 1944, remaining through the nesting season. His third return occurred February 14, 1945, and he was here daily until late July. This male Robin was at least four years old and for more than two years, he has lived the normal life of his species, with seasonal migrations, with the handicap of one eye, the injured eyeball being shrunken and deeply imbedded in the socket.

In 1944 and 1945, he occupied territory adjacent to our house, coming often to the feeding ledge at a window for raisins or to the driveway when food was thrown there. He participated in territorial disputes with another Robin, fighting back when attacked. He was chased and attacked by territory-holding Mockingbirds but, in these instances, he retreated temporarily instead of fighting back. These encounters left him with noticeably disarranged plumage from feather losses where the antagonists had attacked him on the blind side.

He acquired a mate early in each of the two seasons, occupying approximately the same territory. His mate of 1945 joined him in early March and was color-banded soon afterward. She acquired the habit of coming to the feeding place also, and the slam of a casement window brought the pair as well as other species to the house as they soon connected that sound with the appearance of raisins. Here fights sometimes occurred but One-eye never participated in these. His mate sometimes fought a male Mockingbird.

During nesting, he "guarded" frequently, perching on the side of the nest while the female was off. He carried food to the young, and once was seen carrying a moth while pursuing a gray squirrel that had gone near the nest. Because the nests were built too high for examination, data on them are not available.—Amelia R. Laskey, Graybar Lane, Nashville 4, Tenn.

The Return of Robins To Their Birthplaces.—Apropos of Dr. Farner's article under the foregoing title in July, 1945, number of *Bird-Banding*, the following data on the returning of Robins to my station may be of interest. Somewhat to my surprise, they tend to confirm his statement that "there is a marked tendency among Robins *(Turdus migratorius)* to return to their birthplace or its immediate vicinity."

When Banded	Age	Year of Return
June 30, '31	Juv.	1932
Sept. 28, '32	fem. or im.	1933
Oct. 1, '32	fem. or im.	1933
June 30, '31	ad. male	1934
June 20, '33	juv.	1934
June 20, '33	ad. fem.	1934

When Banded	Age	Year of Return
June 25, '33	juv.	1934
Aug. 8, '33	ad. fem.	1934
Oct. 11, '33	ad. fem.	1934
July 28, '33	ad. fem.	1935
July 6, '34	juv.	1935
July 10, '32	juv.	1936
June 18, '34	juv.	1936
July 10, '34	juv.	1936
May 15, '35	Nestling	1936
June 5, '35	Nestling	1936
Aug. 2, '35	juv.	1936
Aug. 11, '34	ad. male	1937
May 6, '36	ad. fem.	1937
July 22, '35	ad. male	1938
May 22, '37	ad. male	1938
June 23, '37	juv.	1938
June 24, '37	juv.	1938
July 29, '37	juv.	1938
June 22, '35	juv.	1939
Sept. 16, '35	juv.	1939
June 24, '37	juv.	1939
June 28, '37	juv.	1939
July 7, '36	juv.	1939
July 6, '37	juv.	1939
July 8, '38	juv.	1939
May 13, '37	ad. fem.	1940
July 3, '39	juv.	1940
July 11, '35	juv.	1941
July 3, '40	juv.	1941
July 4, '39	juv.	1942
June 1, '41	ad. male	1942
Aug. 29, '41	ad. male	1942
Sept. 7, '41	juv.	1942
June 25, '41	ad. fem.	1943
Aug. 16, '42	juv.	1943

Summary: 24 juveniles, 2 nestlings, 9 females, 6 males: Total, 41
Wm. P. Wharton, Groton, Mass.

Chickadee Over Nine Years Old.—In the January, 1945, number of *Bird-Banding* I reported Chickadee No. 36-31053, banded at this station August 21, 1936, as a juvenile, as having been recaptured at the same place on October 31, 1944. Now I am able to report the same bird was taken by me on October 4, 1945. Thus this bird is now in his tenth year.

I might add that 36-31053 had gray feathers surrounding its eyes. It seemed in good condition.—William P. Wharton, Groton, Mass.

A Ten-Year-Old Cardinal.—A postcard recently received from Summerville, S. C., contains the interesting information that the male Cardinal reported on page 160 of the October, 1944, number of *Bird-Banding* is still frequenting the feeding shelf of my former neighbor there. On July 30 of this year, "Grandfather," as he is now called, was feeding two young birds on that shelf, and seemed to be in good health and spirits.—William P. Wharton, Groton, Mass.

Return of White-throated Sparrow to Groton, Mass.—Returns of White-throated Sparrows to my Groton Station have never been recorded but once, and

this record may be of interest to the readers of *Bird-Banding*. White-throat 36-118397, banded September 15, 1936, and taken as a repeat several times up to October 7, staged a return on May 1, 1937, at the same trap site where it had been banded. No repeats were taken that year, nor was this bird trapped in any subsequent year. Although it is possible that 36-118397 may have nested in this region, such nestings are so rare as to make it appear not improbable that the bird was a migrant.

It would be interesting to know if other banders outside of the summer and winter ranges of the White-throat have secured returns of this species.—William P. Wharton, Groton, Mass.

RECENT LITERATURE

Reviews by Donald S. Farner and others

BANDING AND MIGRATION

1. Report of the Bird-Ringing Committee: Progress for 1944. A. Landsborough Thomson. 1945. *British Birds*, 38: 290-294. A total of 6,496 birds were ringed in 1944 in Great Britain, of which 5,313 were nestlings. "Among the recoveries are two of Rooks ringed eleven years before, one as an adult and one as a nestling. A Sandwich Tern over thirteen years old was recovered in northern Spain, and another was found after eleven years in the ternery where it was hatched. A Tufted Duck ringed in St. James's Park in February, 1942, was shot in Novaya Zemlya in the following May; this is by far the highest latitude from which a recovery has ever been reported." Species ringed in the largest numbers since 1909 are: Starling, Song-Thrush, Blackbird, Barn Swallow, Lapwing, Chaffinch, Robin, Manx Shearwater, and Common Tern.—M. M. Nice.

2. Do Birds Cross the Gulf of Mexico in Spring? George G. Williams. 1945. *Auk*, 62(1): 98-111. Very frequently in science a theory proposed by a dynamic leader is accepted without question and remains unchallenged and largely uninvestigated for many years. The author believes that the theory of trans-Gulf migration should be challenged. The late W. W. Cooke, who first proposed the theory, based it on three lines of evidence, none of which, according to the author, stand up under critical scrutiny. First, the author can find no really reliable reports of large numbers of land birds actually seen migrating or on ships more than fifty miles off shore; birds seen closer might have been blown off shore by storms, especially since resident birds are often included. Secondly, recent study of migration on the Texas coast indicates that the same species occur there in spring as on the Louisiana coast. Finally, the reputed simultaneous arrival of birds along the Gulf Coast is not considered sufficiently proven. While the author thus shows that direct evidence for trans-Gulf migration is much weaker than generally supposed and that many individuals of species supposed to cross the Gulf apparently migrate around the Gulf (or at least touch at points around the periphery), it should be noted that the evidence presented is not sufficient to cause an immediate or complete abandonment of the trans-Gulf theory. In many ways the author seems too dogmatic in some of his statements. Someone needs to park astride the supposed route over the Gulf and see if birds actually fly over in large numbers. Contrary evidence, such as presented by Lowery and Van Tyne, needs to be further amplified. It seems not unreasonable to suppose that large numbers of individuals may take both routes, or some individuals may cross the Gulf in one hop under favorable conditions, and others land on the periphery to continue their journey *via* land. This paper will indeed stimulate discussions and observations.—E. P. Odum.

3. Trans-Gulf Migration of Birds and the Coastal Hiatus. George H. Lowery, Jr. 1945. *Wilson Bulletin*, 57(2): 92-121. The rarity of migration records for many transient species from a broad zone along the north coast of the Gulf of Mexico indicates that spring migrants normally pass on, without stopping, to inland localities in the latitude of Memphis, Tennessee. Spectacular concentrations of transients may, however, appear in the groves and marshes immediately bordering the Gulf during and immediately following storms. Spring storms in this area are precipitated by cold northerly winds meeting and sweeping under warm moisture laden air masses of the Gulf. Trans-Gulf migrants encountering such storms are thought to drop to low altitudes and seek refuge on the first land they encounter. Here they remain only until the advent of good weather, usually within a few days. Again the coastal zone is bypassed as the birds move on to inland localities in a single flight.

Data are presented which indicate that stormy weather along the south coast of the Gulf delays the departure of trans-Gulf migrants causing interruptions in the northbound stream of migration. This and the storm-caused delays on the north coast are thought to account for the uneven flow or "waves" characteristic of the spring migration in the Mississippi valley.

In this paper the author has accepted the assumption proposed by W. W. Cooke in 1888 that migrants arriving on the coast strip or at inland localities have moved in across the Gulf. Since Mr. Lowery's paper was submitted, an article by G. G. Williams has appeared in the (*Auk*, 62(1): 98) which attempts to disprove this basic assumption and demonstrate a narrow coastwise migration route from which northbound flights branch at various points. It will be interesting to read the accounts of further observations on trans-Gulf migration which Mr. Lowery is reported to be making.—J. T. Emlen, Jr.

4. The Homing Instinct in Pigeons. C. S. Platt and R. S. Dare. 1945. *Science*, vol. 101, no. 2626: 440-441. Despite the great quantities of observations and records which thousands of pigeon racers have made on the homing capabilities and training requirements of their birds, very little of a scientific nature has been published on the sensory basis of homing abilities in pigeons. The paper under review makes a start in this direction. A few simple experiments were conducted between two stations 80 miles apart in New Jersey. Inexperienced pigeons failed to return over this course. Pigeons trained over half the distance similarly failed. Individuals which had covered the course once or twice with a group of trained birds found their way back by themselves in six out of nine cases. The conclusions support those drawn by Whitman in 1919 that homing in pigeons is dependent on the recognition of familiar landmarks.—J. T. Emlen, Jr.

ECOLOGY AND POPULATION

5. Some Changes in the Bird Life of Churchill, Manitoba. A. A. Allen. 1945. *Auk*, 62(1): 129-134. Observations in 1944 are compared with those of Taverner and Sutton in 1934. The building of an airport and other war activity have changed the immediate vicinity of Churchill to some extent, some dwarf spruce being removed for one thing. Seven species which commonly thrive near civilization, such as House Wren, starling, cowbird, Song Sparrow, recorded in 1944 were not present in 1934. Robins have increased. Hudsonian Curlew and Dowitcher were more abundant in 1944, probably reflecting the general increase in these species. Ptarmigan, Stilt Sandpiper, Tree Sparrow, Redpoll, and others seemed to be scarcer. Smith's Longspurs have apparently increased, while Lapland Longspurs have decreased.—E. P. Odum.

6. The Breeding Distribution, History and Population of the North Atlantic Gannet *(Sula bassana)*. Part 2. The Changes in the World Numbers

of the Gannet in a Century. James Fisher and H. G. Vevers. 1944. *Jour. Animal Ecology*, 13: 49-62. In 1939 the world population of the Gannet was 165,600 ± 9,500 "In 1834 the world population was of the order of 334,000 breeding individuals, of which two-thirds (approximately) were breeding on the Bird Rocks in the Gulf of St. Lawrence. There was a steady decrease in the world population, mainly owing to the depredations of man at the Bird Rocks, until about 1894, when it was of the order of 106,000 breeding individuals." Since then, "there was a steady recovery in numbers, and an establishment of new colonies, some now large and successful. . . . The rise in the numbers of the gannet has taken place in a period in which man still exploits the gannet; protection has stopped the unplanned destruction, which, if continued, would have made an end of the gannet in some parts of its limited range; . . . and most of the 22 colonies where the gannet is now breeding are entirely protected. . . When small numbers of gannets are present at a colony, breeding is abnormally inefficient"—M. M. Nice.

7. Winter Habits of Crows in Oklahoma. Shaler E. Aldons. 1944. *Journal of Wildlife Management*, 8(4): 290-295. Crows have increased markedly in Oklahoma during the past thirty years despite control activities. This increase is attributed to increasing food supplies on the wintering range in Oklahoma and on the summer range in Canada. Twenty-four winter roosts were located varying in size from small groups to huge concentrations of 200,000 or more birds. Individual crows ranged out from their roosts for 8–12 miles and returned over the same flight lines each day as indicated by repeats of banded birds. Pellets, which were used in food habits studies, were regurgitated within two hours after the birds entered their roost.

Both the eastern and the western races (*brachyrhynchos* and *hesperis*) were represented.—J. T. Emlen, Jr.

PHYSIOLOGY

8. The Effect of Auditory Stimulation on the Spermatogenetic Cycle of the Male English Sparrow. C. S. Thornton and S. B. Cummings, Jr.; assisted by Frederick Greeley. 1945. *Auk*, 62(1): 75-79. Forty days of noise produced by an electric buzzer failed to have the slightest stimulatory effect on English Sparrow testes, while increased light caused marked enlargement as has been demonstrated previously. While these experiments are clear-cut and a good contribution to the "periodism" problem, sweeping conclusions are not yet justified. For example, in stating that previous workers "have proved without a doubt that exercise has no effect on the avian sexual cycle," the authors overlook the recent work by Wolfson (*Condor*, 43: 125-136, 1941) which indicates that activity is not yet to be ruled out. From the relatively small amount of experimental work so far reported, the reviewer is not convinced that sweeping conclusions of any sort are justified. For one thing, physiologists are often prone to speak of the condition "in birds" when experiments refer to particular species. Of course, basic physiological responses will be similar "in birds," but the "trigger" which sets off the chain of events may well vary with the species.—E. P. Odum.

9. Some Effects of Sex Steroids on the Gonads of the Starling. J. Wendell Burger. 1945. *Endocrinology*, 37(2): 77-82. Male and female sex hormones (testosterone propionate and estradiol dipropionate) had no effect on sexually inactive ovaries of starlings. Estradiol and its propionate suppressed spermatogenesis and augmented the growth of intertubular tissue in testes. Testosterone propionate neutralized these effects of estradiol. Testosterone did not augment spermatogonial multiplication in inactive testes but appeared to sustain and reinforce the later stages of spermatogenesis.—J. T. Emlen, Jr.

10. Color Vision and Brightness Discrimination in the Little Owl. (Farbensehen und Helligkeitsunterscheidung beim Steinkauz (*Athene noctua vidalii* A. E. Brehm)). J. T. V. Meijknecht. 1941. *Ardea* 30: 129-173. Also published separately, E. J. Brill, Leiden. It has been found that three diurnal birds have excellent color vision and light discrimination—the Song Thrush, domestic fowl, and Shell Parakeet. Nocturnal birds have relatively more rods and fewer cones in their retinas than diurnal birds, and also color could not play the large role in their lives that it does with the latter. A series of careful and convincing experiments with nine Little Owls are described: these birds were found to distinguish red, yellow, green and blue, and also to be extraordinarily sensitive in distinguishing shades of gray. Three Song Thrushes were then tested on shades of gray; they were found less sensitive than the owls, but more sensitive than human beings. The author concludes that since no explanation can be found for the Little Owl's color vision in its mode of life, that color vision cannot be a recent adaptation, but must be characteristic of a larger taxonomic group.—M. M. Nice.

11. Molt in Flight Feathers of Flickers. Frederick H. Test. 1945. *Condor*, 47(2): 63-72. The annual fall and postjuvenal molt of primary feathers proceeds in sequence from primary one. Postjuvenal molt of the secondaries is generally omitted, but the annual fall molt proceeds from two centers of initiation at secondaries eight and one. This double origin of the molt sequence is thought to be related to the double embryonic origin of the secondaries demonstrated by Steiner. Measurements of growing feathers show growth rates of 5 to 7 millimeters per day for primaries, 4 to 5 millimeters per day for secondaries.—J. T. Emlen, Jr.

ANATOMY

12. Flying Ability and the Anterior Intermuscular Line on the Coracoid. Harvey I. Fisher. 1945. *Auk*, 62(1): 125-129. A study of the relative position of the supracoracoideus and coracobrachialis posterior muscles as indicated by the line between the origins of these muscles on the coracoid of species of widely different flight abilities indicates that this intermuscular line is not an index to the ability to fly. Hence, this bone marking cannot be used to indicate flight ability of fossil specimens.—E. P. Odum.

BEHAVIOR

13. An Objectivistic Study of the Innate Behaviour of Animals. N. Tinbergen. 1942. *Bibliotheca Biotheoretica*, Ser. D. Vol. I—Pars 2: 39-98. An excellent presentation of problems of animal behavior, emphasizing many of the views of Heinroth, Lorenz and the author with examples from birds, fish, mammals and insects. "Objectivistic Ethology . . . is applying *physiological methods* to the *objects* of animal Psychology" (p. 40). In "Objectivistic Comparative Ethology . . . there is a need for ever *increasing detailedness* . . . consideration of the *whole* behaviour pattern of a species is necessary . . . *comparison* of behaviour patterns of many different species is needed" (p. 43). In discussing the "casual analysis of innate behaviour," Dr. Tinbergen states that: "most activities are released by internal and external factors in cooperation" (p. 52) and "intensive internal stimulation (at the end of the season) compensates for low external stimulation; in the beginning of the season, the low intensity of the internal factor can only be compensated by a high temperature" (p. 54). An interesting diagram is given showing the "hierarchy of drives" in a male Stickleback: on the lowest level is the reproductive drive; on the next come fighting, building, courting, care for offspring; and finally the instinctive actions (inherited

coordinations), as biting, chasing, threatening, etc.; digging, testing of materials, and so on. An illuminating discussion of taxis, signals, releasers, etc., is given.

Under "Some Remarks on Learning Process," we learn that: "The learning achievements of Honey-Bees and of digger wasps during their 'locality studies' are almost unbelievable. . . . At the same time, the whole chain of activities leading to the capture of the prey, an entirely innate behaviour pattern, is never changed nor guided by experience." A Herring Gull that lays "blue" eggs does not know these from normal ones, but learns to distinguish its own chicks in five days. Hence, in studying learning, we should "know which of the animal's activities have to be chosen when its best achievements in this line must be found and used for comparison" (p. 82). The last section is on "Functions of Behaviour." "The function of an activity is always the attainment of a certain end with the aid of certain morphological structures" (p. 85). "The performance of the instinctive activity in itself is the animal's goal" (p. 84). A most valuable paper, a boon for all of us, interested in animal (and bird) behavior, who can better understand theories presented in English rather than German or Dutch.—M. M. Nice.

14. Substitute Activities. (Die Uebersprungbewegung.) N. Tinbergen. 1940. *Zeitschrift für Tierpsychologie*, 4: 1-40. A detailed analysis and discussion with many examples drawn from birds and fishes. Substitute activity occurs when a drive is inhibited; this may take place when antagonistic drives are stimulated at the same time; when a goal is too suddenly reached; and when the necessary stimulus in a chain of activities is lacking. Substitute activity in birds may take the form of pretense of feeding, preening, bathing, nest-building, etc., in primates there may be grooming of the fur, and in man head scratching (innate), taking out the watch, lighting a cigarette (acquired). Substitute activities have often evolved into signals that release behavior in other individuals of the species. Many of these have become ritualized, and recognition of the origin of the movement is only possible through homologisation based upon comparison with other species. A paper that deserves careful study.—M. M. Nice.

15. Song-Thrush Song. Noble Rollin. 1945. *British Birds*, 38: 262-270. Observations on several Song-Thrushes (*Turdus e. ericetorum*), illustrated with 5 graphs. An unmated bird on April 9 spent ten hours singing (41% of the 24-hour day), nine hours in roosting (38%) and five hours (21%) in feeding, etc. (My unmated Song Sparrow (*Melospiza melodia*) on May 11 spent nine hours in singing and nine hours sleeping, which left six hours (24%) for other occupations.) "The unmated Song-Thrush averaged about 38 seconds of song for every minute it was occupied in singing"; thus on April 9 there were 377 minutes of actual song. Another bird on June 13, "apparently pairing," gave 217 minutes of song, while a third, feeding young on June 12, gave 33 minutes." (The Song Sparrow spends something like twelve seconds in actual singing during each minute he devotes to song; this would bring the output on May 11 to 96 minutes.) The first song of Song-Thrushes "varied from a mean of 52 minutes before sunrise in March to a mean of 71 minutes in the first half of June."—M. M. Nice.

16. Singing of Breeding Female Chaffinch. M. D. England. 1945. *British Birds*, 38: 274. A female *Fringilla coelebs gengleri* near Tring "sang persistently." "The song was very similar to that of the Lesser Whitethroat (*Sylvia curruca*) and was usually delivered from the tree in which the nest was built, or one near it. . . . The song appeared to puzzle the male and the nuptial chasing often started as a battle. He would fly to the tree in which his mate was singing, in a very belligerent way, with much 'spink, spink-ing,' and apparently attack her." She stopped singing after laying her third egg, but started again "in a desultory way" after the nest was robbed. The second attempt at nesting was successful

and the female's behavior normal, "except that the cock did the major share of feeding and nest-cleaning. He spent a lot of his time chasing her to her duties." —M. M. Nice.

17. The Breeding of Black-winged Stilts in Nottinghamshire in 1945. J. Staton. 1945. *British Birds*, 38: 322-328. In 1945 there was a notable immigration of *Himantopus h. himantopus* into the British Isles, where before it had been known only as a rare vagrant; the raising of three young by two pairs is reported in the present paper, which is illustrated with photographs of nest and eggs and a two-week-old chick found dead, and a sketch of a remarkable wing-flapping display. The four adults were "very aggressive to other birds, notably Carrion-Crows and Black-headed Gulls, passing through the area, and continually mobbing human intruders." The young flew when a month old. "The wing-flapping display consisted of any individual bird prancing up and down in one spot, with the body in a curious, almost vertical position, and the wings extended forward and beating slowly and rhythmically. It was almost an exact parallel of the wing-waving of unmated Starlings, and though it doubtless occurred earlier, was seen by observers chiefly in the late stages of incubation and during the early days after the chicks were hatched, particularly when nest-site or vicinity of chicks were approached."—M. M. Nice.

18. On the Nuptial Display of the Redstart. E. J. M. Buxton. 1945. *British Birds*, 38: 282-287. Interesting and detailed observations made while the author was a prisoner in Germany. The red tails of *Phoenicurus ph. phoenicurus*, especially when seen from below with the sun shining through them, are very conspicuous in the nuptial displays. "Beginning with chases in and about the trees where the future nest is to be built, the elaborate display, without which coition is not even attempted, was not seen until after nest-building had started. . . . The displaying male, with his bright tail fanned and pressed down onto the branch, his rosy body flattened, his black face and white cap thrust toward the hen; with his wings held straight up to show their shimmering pink undersides as he excitedly quivers them; his wild, darting flight after the act, accompanied by a sweet warbling song as he flies—all combine to make one of the most strikingly lovely scenes I have ever watched in the lives of birds."—M. M. Nice.

19. Notes on the Roosting of Certain Birds. Christopher M. Swaine. 1945. *British Birds*, 38: 329-332. Notes on 23 species, dealing "mainly with unusual or unrecorded roosting-sites or with species whose roosting habits are but little known."—M. M. Nice.

20. Observations on a Tame Robin. M. Brooks-King. 1944. *British Birds*, 38: 130-132. A young *Erithacus rubecula melophilus* became so addicted to taking meals in the author's house that in the fall when two adult robins took up territory around the house, the young bird, called C, retreated into the house, where he was saved from his rivals by the family closing the windows. When he completed his molt and attained full voice, he took over the house as his territory and defended it from the outsiders. In spring he got a mate and they nested near the house; C fed his mate and young with butter and margarine.—M. M. Nice.

21. Possible Life-Pairing of Nuthatch. David Lack. 1945. *British Birds*, 38: 297. A pair of *Sitta europea affinis*, banded in the winter of 1939-40, was found alive and in the same territory in April, 1945. "Steinfatt (*Beitr. z. Fortpfl. d. Vögel*, Vol. 14, p. 86, 1938) considers that the Nuthatch probably pairs for life." —M. M. Nice.

22. Black-headed Gull Feeding Independent Young. J. A. G. Barnes. 1945. *British Birds*, 38:299-300. A young *Larus r. ridibundus*, apparently physi-

cally normal, was fed by an adult from the end of August until it was last seen on Feb. 18, although it got some food for itself. "The young bird would recognize its 'parent' in flight and begin bowing and whistling before the adult alighted. . . . The parent occasionally brought food in its bill, . . . but feeding by regurgitation either on land or water was much more frequent. . . . It regularly drove off other Black-headed and Common Gulls near the juvenile."—M. M. Nice.

23. Herring-Gulls Robbing Lapwings. F. J. Johnston. 1945. *British Birds*, 38:278. On Jan. 23, 1945, seven *Larus a. argentatus* were standing on upland grassland with 35 *Vanellus vanellus;* the latter were busily seeking food while the former stood watching, but whenever a Lapwing found something, it was attacked by one or more Gulls. "Such behaviour is well known in the case of Black-headed Gulls *(Larus ridibundus)* . . . but not mentioned in *The Handbook* in other species."—M. M. Nice.

24. Observations on the Birds of Wake Island. Charles Vaughn. 1945. *Migrant*, 16: 26-28. A delightful account of the Flightless Rail *(Rallus wakensis)* in 1938; now without doubt it has been exterminated. These birds "travel around with, and even eat from the same dish with, the small vegetation-eating rats that infest the island. Long unacquainted with human beings and therefore unafraid, they have become very friendly with our men during the three years the Pacific Airways have occupied the island. They stand by dozens on the steps of the hotel kitchen door, peering through the screen at the staff and going crazy with delight when one of the Chinamore kitchen boys comes out with scraps for them. They walk over his shoes and jump high in the air, just like young chickens at feeding time. During the heat of the day, they get under the hotel or go down into the rat burrows to keep cool; at night, they go foraging abroad with the rats. . . . They nest on bare sand at the base of the scrubby beech magnolias, laying a clutch of four or five eggs."—M. M. Nice.

LIFE HISTORY

25. Incubation and Nestling Periods of Central American Birds. Alexander F. Skutch. 1945. *Auk*, 62(1): 8-37. The author tabulates egg measurements, incubation and nestling periods of several hundred nestings, involving over a hundred species of 44 families of Central American birds,—indeed an impressive array of data, especially valuable because they were gathered by one observer. A rather rambling but very interesting discussion of factors which may affect length of incubation periods follows. The author believes his data support Bergtold's contention that taxonomic position affects the length of incubation, birds of "higher" groups having shorter periods. Flycatchers, for example, have considerably longer incubation periods than tanagers, honey creepers, and thrushes, even though egg sizes and nesting habits are comparable between these groups. Exceptions appear, however, as many doves have very short periods (only ten days in the Ruddy Quail Dove) despite "low" taxonomic position. Correlation with mortality rate (or "ecological factors") seems to be indicated within the flycatcher group, since species building hanging nests less accessible to predators have longer incubation periods than those building more conventional nests, even though a number of the latter lay larger eggs. Interestingly enough, this may be the result of a behaviour difference rather than an inherent difference in the egg since the hanging nest species appear to incubate less constantly. Size of the egg is, of course, a third major factor to be considered. While a rough relation is granted, data on flycatchers and thrushes show a lack of correlation between egg size and the length of incubation. Nestling periods, with the exception of hole nesters and long-winged species, are generally the same length as incubation periods.

As the author points out, more accurate information is needed, since it is apparent that many factors influence the length of incubation. In this paper, the author does not consider experimental work such as that of Kendeigh and Romanoff which does throw light on factors governing incubation length. With a problem as complicated as this, it is obvious that both sound observation and critical experiments on the physiology of development are necessary. General observation can only suggest hypotheses; experiments or critical observations must be used to test them. This paper is important in the former respect.—E. P. Odum.

26. A Study of the Northern Raven. W. Bryant Tyrrell. 1945. *Auk*, 62(1): 1-7. Observations made on seventeen week-end visits to three raven nests in the Shenandoah National Park (Va.) are discussed. The raven may be increasing in the Park as a result of protection. Three to seven eggs were laid early in March, incubation period about three weeks, nestling period about five weeks. One pair was bold, another shy when the nest was approached, but neither would visit the nest while under observation, so that little concerning nest behaviour or food habits could be observed. Recently hatched nestlings remained warm, possibly indicating an early development of temperature regulation.—E. P. Odum.

27. Observations of the Loon in the Cariboo Parklands, British Columbia. J. A. Munro. 1945. *Auk*, 62(1): 38-49. The Loon *(Gavia immer)* population in interior British Columbia seems relatively constant, large lakes having about the same number of pairs every year and the same small lakes having single pairs. The presence of fish is not necessary since 28 (out of 107) adults occupied small fishless lakes. From May to mid-August, pairs spend all their time on a definite circumscribed territory which is usually defended early in the season, except against non-breeding individuals; pairs unsuccessful in nesting defend territories longer than those which are successful. Nests may be placed on old muskrat houses, floating vegetation or on shore, but a deep escape channel is always nearby. Males perform spectacularly and fearlessly when nest or young are approached (photographs included), creating a great commotion in the water or "standing nearly upright with neck curved back, chest outthrust, wings half opened and curved forward," accompanied by vigorous calling. Territory defense behaviour is similar but not so vigorous. Most eggs hatch, but many young seem not to survive, since the number of young seen in late summer is small. There is also apparently a large percentage of non-breeding pairs and single birds. Of five birds collected, the stomach of only one held fish; amphipods, mollusca, and aquatic insects were found in the others. Fish probably constitute a good part of the diet on some lakes, however.—E. P. Odum.

28. The Nestling of the Sooty Shearwater. L. E. Richdale. 1945. *Condor*, 47(2): 45-62. The average incubation period for this species was confirmed as eight weeks. Eggs on Whero Island hatched between January 17 and February 4 (88 records in four seasons). Hatching, from first chipping until emergence, took at least four days. The down-covered chicks developed slowly and remained ashore for at least 95 days. They were parasitized with fleas and ticks. Parent shearwaters apparently ranged widely and returned to feed their young irregularly. The times of feeding and the approximate sizes of meals delivered were determined by weighing individual chicks at 9 a.m. and 9 p.m. each day. Eleven chicks so studied were fed on 192 nights and remained unfed on 215 nights. Fasting periods were commonly five days and on one occasion extended for ten days. Single meals ranged up to 300 grams in weight and on several occasions nearly equalled the weight of the bird receiving them.

Growth curves based on body weight were highly irregular and quite meaningless. Bill, wing, toe, and claw measurements increased regularly during the first seven weeks (after which regular observations were discontinued), and had ap-

proached the adult condition by May. The exact dates of departure of the birds from nesting islands were not determined.—J. T. EMLEN, JR.

29. On the Habits and Nest of the Ant-Thrush Formicarius analis. Alexander F. Skutch. 1945. *Wilson Bulletin*, 57(2): 122-128. Observations on this strictly terrestrial ant-bird were made in Panamá and Costa Rica. It nests in tree cavities. Two eggs are laid and both sexes incubate. Of special interest is the observation that the nestlings at hatching are covered with down.—J. T. EMLEN, JR.

30. Nesting of the Allen Hummingbird. Elmer C. Aldrich. 1945. *Condor*, 47(4): 137-148. Information on nesting sites, nest construction, eggs and incubation are presented on the basis of observations on about 50 nests. Nest building may occupy eight to eleven days before the eggs are laid and is continued until the young leave. Two eggs are laid, generally about two days apart. Incubation begins with the laying of the first egg and lasts from 17 to 22 days. Tabular presentation of data would have increased the usefulness of this paper. —J. T. EMLEN, JR.

31. The Nesting of the Long-tailed Tit. J. H. Owen. 1945. *British Birds*, 38: 271-273. Five years' observations on the elaborate nests constructed by *Aegithalos caudatus;* materials for the outside of the nest are found in the vicinity, but the birds will go far for feathers, at least a quarter of a mile. In six nests the number of feathers ranged from 985 to 2,084, averaging 1,558. About 21 days are spent in building the nest. "In three cases in 1943 three birds were interested in the nests." The average number of eggs is about eleven. "Soon after the outer nest is completed the two birds use it as a dormitory and continue to do so until the young are fledged." Incubation lasts at least fourteen days; fledging at least sixteen days. "The rearing of the young is extremely successful. This can be seen to a great extent by the count of the families seen in autumn and winter, for the family keeps together after leaving the nest."—M. M. NICE.

32. Fertility and Mortality in the Nest of Continental Great Tits. E. J. M. Buxton. 1945. *British Birds*, 38: 288-289. In 1944 while a prisoner in Bavaria, the author marked with colored bands, supplied by Dr. E. Stresemann, a number of pairs of *Parus m. major;* 87 eggs were laid in nine nestings; 68 hatched and 51 young were fledged, 59 per cent success. The sets ranged from 7 to 16 eggs. In one, all nine eggs were infertile, the female incubating them for at least 24 days; if this set is omitted, fledging success came to 65 per cent, which is typical of hole-nesting species. Nesting was two or three weeks later than in 1943 owing to cold, wet weather; only one pair attempted a second brood. —M. M. NICE.

33. Nesting of Western Bluebird. Kenneth Racey. 1945. *Canadian Field-Naturalist*, 59: 43. Two weeks before the second brood of *Sialia mexicana* "left their nesting box in early July, a second pair of adult bluebirds joined forces with the nesting birds, and together they fed the young until fledged."—M. M. NICE.

SEX RATIOS

34. Sex Ratios of Ducks in Southwestern Washington. James R. Beer. 1945. *Auk*, 62(1): 117-124. This contribution to the sex ratio problem in ducks is especially interesting because all observations were made directly in the field, some 10,130 ducks of fifteen species being counted as to sex. As indicated elsewhere (see *Bird-Banding*, 16: 109), banding traps and perhaps hunters' bags may

not be a fair sample, as males may be more vulnerable to these sample methods. In this study the sex differential favoring males is only 1.18 to 1. Among the Anatinae the ratio was practically even, while among the diving ducks ratios were more unbalanced in favor of males. There seemed to be little difference in ratios in fall, winter, and spring, with only a slight tendency for males to leave wintering areas first. The author believes the cause of unbalanced ratios will be found on the nesting ground, as no factor causing a difference was noted on the wintering ground.—E. P. Odum.

35. Sex and Age Ratios Among Bobwhite Quail in Southern Missouri. A. Starker Leopold. 1945. *Journal of Wildlife Management*, 9(1): 30-34. This paper presents records on the sexes of 45,452, and the ages of 7,700 Bobwhite Quail shot in Missouri during the hunting seasons of 1939-1943. Young of the year constituted from 72 to 83 per cent of total; the proportion of young was greater in agricultural than in wooded areas. Age ratios in one county fluctuated from year to year between 72 and 82 per cent; these changes are attributed to the effects of spring weather on reproductive success. The total sex ratio of 53.1 per cent males agrees well with published reports from other areas. Males and females were equally represented among young of the year, but males predominated in the adults. The differential loss of adult females is thought to occur during the breeding season. The average weight of 166 quail was 186 grams, 21 grams more than the average weight given by Stoddard for Georgia birds.—J. T. Emlen, Jr.

CONSERVATION AND WILDLIFE MANAGEMENT

36. Bird Geography in the Southwest Pacific. Bird Habitats of the Southwest Pacific. Bird Conservation Problems in the Southwest Pacific. Ernst Mayr. 1945. *Audubon Magazine*, 47: 159-165; 207-211; 279-282. Very fine articles, illustrated with picture-maps and sketches. The last is an eloquent presentation of the desperate situation of these island faunas, where "More kinds of birds have become extinct on the islands of the Pacific than in all the rest of the world put together." A few simple rules are recommended: "No needless destruction of trees. No deliberate starting of brush and grass fires. No indiscriminate shooting or killing. No introduction of cats, goats, or other non-indigenous mammals or birds. Rigid control of rats. No random scattering of DDT or other poisons." "If the existing conservation organizations are not in a position to meet this emergency, I suggest that a new organization be formed for the preservation of the fauna of the Pacific. The time has come to act."—M. M. Nice.

37. An Improved Game Bird Trap. H. L. Kutz. 1945. *Journal of Wildlife Management*, 9(1): 35-38. A collapsible and portable funnel type trap measuring 6′ x 6′ x 3′ is described and figured. The sides are constructed of welded wire fabric and the top of fish seine netting in order to avert injury to captured birds. A "predator skirt" reduces losses by ground predators. The trap has been used successfully for pheasants and waterfowl in New York State.—J. T. Emlen, Jr.

38. The Kettleman Hills Quail Project. B. Glading, R. W. Enderlin and H. A. Hjersman. 1945. *California Fish and Game*, 31(3): 139-156. An area of approximately 75 square miles in the arid Kettleman Hills of California was the locality selected for three experiments on increasing quail by environmental manipulation.

In the first experiment supplementary food in the form of grain was broadcast three times per week in two large plots while two other plots were kept as con-

trols. Quail increased significantly in the fed plots, but the gains were not considered adequate to warrant the expense in practical management programs. Song birds, rabbits and rodents also responded to the feeding program in varying degrees, but predators showed no increase during the two-year study period.

The second experiment was designed to test the value of stocking new quail range around isolated watering installations with introduced birds. Marked quail released at two such stations in October, directly or after a period of adjustment in confinement, all disappeared within a few days. These stations and an unstocked "control" station were all utilized by quail (but not the marked birds) during the two following summers. From this it was concluded that the stocking of such areas (within two miles of quail range) is quite useless.

The third experiment involved all-round development of the land for quail, including, especially, water and roosting cover improvements. Preliminary results suggest that the area can be successfully developed as a "natural game farm" from which an annual trappable surplus of birds may be taken for transplanting. —J. T. Emlen, Jr.

FOOD HABITS

39. Food Habits of the Barn Owl. Albert C. Hawbecker. 1945. *Condor*, 47(4): 161-166. This study is based on the analysis of 480 pellets collected during the nesting season from eleven nests or roosting sites in central California. The occurrence of prey species in the pellets could, in a general way, be correlated with abundance and accessibility (ease of approach) in a collecting locality. The absence in one collection of rodents known to be common one-fourth of a mile from the collecting site suggests a restricted foraging range.—J. T. Emlen, Jr.

PARASITOLOGY AND DISEASE

40. Maggot Infestation of Nestling Mourning Doves. Johnson A. Neff. 1945. *Condor*, 47(2): 73-76. Mourning Dove nests in the San Joaquin Valley of California were heavily infested with maggots of a previously undescribed species of blow fly (Protocalliphora). As many as 50 per cent of nests observed were infested with between 20 and 86 maggots per nest. The maggots attack nestlings at any time of day or night, attaching themselves to the ears, nostrils and among the pin-feathers on various parts of the body. Nestling doves became restless when attacked and frequently fell from their nests. These parasites are believed to be an important factor in the heavy nest mortality observed in this area between 1936 and 1940.—J. T. Emlen, Jr.

41. Effects of Lead Poisoning on Reproduction of Mallard Drakes. E. L. Cheatum and Dirck Benson. 1945. *Journ. Wildlife Management* 9(1): 26-29. Eggs fertilized by eight game-farm mallard drakes which had recovered from severe lead poisoning showed no reduction in fertility, hatchability or survival of ducklings. The effect of lowered vitality on reproduction during periods of absorption and convalescence from lead poisoning is recognized, but, it is noted, wild ducks have much less opportunity to pick up shot and become poisoned in spring than in fall.

Admittedly meager data suggest that when birds ingest three or four No. 4 shot separately, at intervals over a period of two months, mortality by lead poisoning may approximate 20 per cent.—J. T. Emlen, Jr.

DISTRIBUTION

42. The European Starling in Gaspe. Stanley C. Ball. 1945. *Auk*, 62(1): 79-97. Starlings first appearing at Gaspe in 1935 have become "cliff

dwellers" on the Forillon, nesting in limestone crevices after the manner of Guillemots. One brood is apparently raised. Until hatching in June, the adults are very secretive; the young appear in July. A few individuals remain through the winter, but most migrate southward. Nest sites on cliffs are always near fish dressing stations or fisherman's barnyards and gardens, to which adults repair for food. During one year, crows destroyed nests, constituting effective control.—E. P. Odum.

43. The Birds of the Cariboo Parklands, British Columbia. J. A. Munro. 1945. *Canadian Journal of Research*, 23, Sect. D: 17-103. A detailed account of 212 species and subspecies of birds known to occur in the interior plateau between 51° and 53° north latitude and 120° and 126° west longitude. "Composite forests of lodgepole pine and aspen, grasslands, and shallow valleys containing numerous lakes, ponds, and marshes of various types are the principal physiographical features. Ten vertebrate habitats, each with a characteristic biota, are recognized." "The biota is in rapid process of modification as a result of various human activities." Examples of the many valuable life history observations: Barrow Golden-eye (*Glaucionetta islandica*) the most common nesting duck, does not breed until two years old; yearling females frequently attach themselves to nesting females and their broods. Three female Green-winged Teal (*Nettion carolinense*) displayed in front of the author's canoe, while their 19, three-quarters grown young, made off down the creek. The Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) is increasing, apparently at the expense of the Redwinged Blackbird (*Agelaius phoeniceus*); numbers of the two species nesting in 14 localities in 1942 are given for future reference. A most admirable piece of work.—M. M. Nice.

SYSTEMATIC ORNITHOLOGY

44. Distribution and Taxonomy of the Black-capped Chickadees of North America. Allen J. Duvall. 1945. *Auk*, 62(1): 49-69. Nine subspecies of *Parus atricapillus*, namely *atricapillus*, *practicus*, *anamesus*, *frigoris*, *septentrionalis*, *nevadensis*, *fortuitus*, *occidentalis* and *turneri*, are recognized in this thorough revision based on a study of 800 specimens. An interesting problem is posed by the striking similarity of Eastern *atricapillus* and *fortuitus* of Washington, although geographically widely separated. Likewise, *nevadensis* of Great Basin and *turneri* of Alaska are very similar, exceeding in pallor all other races.—E. P. Odum.

45. Notes on Panamanian Birds. John W. Aldrich. 1945. *Auk*, 62(1): 111-114. Specimens of *Ammodramus savannarum obscurus* and *Lochmias nematura nelsoni*, new subspecies collected by E. A. Goldman in Panamá in 1911-1912 have apparently been overlooked by subsequent workers.—E. P. Odum.

CORRECTION

Mr. B. W. Tucker, editor of *British Birds* has called attention to a series of errors in *Bird-Banding*, Vol. 16, No. 2, p. 78, reviews 53, 54, 55 and 56. These reviews all refer to the same article on the Little Ringed Plover, of which Nos. 54, 55 and 56 are subheadings. It is said in the review that prior to 1944 there were only about a dozen breeding records for Britain, whereas it was stated in the paper that there was only about that number of records for the bird in Britain at all and but one previous breeding record, that in 1938. Furthermore,

the review states that "neither of the 1944 birds were members of the 1938 pair since both members of the latter were banded and neither of the 1944 birds has bands." Here again the paper states that the 1938 young were banded, not the adults.

NOTICE

The cooperation of bird-banders has been solicited in supplying English Sparrows and Starlings for use in laboratory work.

Miss Elizabeth M. Boyd, Dept. of Entomology, Cornell University, Ithaca, New York, is making a study of ectoparasites and intestinal worms of English Sparrows and Starlings and is desirous of obtaining live specimens of these birds over a wide area of distribution. Shipment may be made in a corrugated box with a few perforations and containing grain and sectioned apples, and sent Express collect to Miss Boyd at the address given above. Miss Boyd will be glad to furnish containers upon request and to reimburse for any expense involved.

Mr. George A. Bartholomew, Jr., wishes to secure English Sparrows for experiments on the effects of light intensity on reproductive development. Banders living in the vicinity of Boston who catch any of these birds are requested to call Mr. Bartholomew at WATertown 6167 and he will gladly call for the birds; sparrows from more distant points may be sent to the Biological Laboratories, Harvard University, Divinity Avenue, Cambridge, Massachusetts, via Express collect.

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